# ENGINEERING EVALUATION & COST ANALYSIS

*For*

## PROPOSED REMOVAL ACTION

*At*

## PACIFIC MINE
## PACIFIC MILL
## BLUE ROCK MINE
## SCOTCHMAN #2 MINE

**Privately Owned Lands Managed or Owned By**
**SNOWBIRD CORPORATION**
**In**
**American Fork Canyon**

**Project Proposed and EE/CA Prepared By**
**TROUT UNLIMITED**

**December, 2004**

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## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AFC | American Fork Canyon |
| ARAR | Applicable or Relevant and Appropriate Requirement |
| ARD | Acid Rock Drainage |
| ATV | All Terrain Vehicle |
| BLM | Bureau of Land Management |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act |
| CERCLIS | Comprehensive Environmental Response, Compensation and Liability Information System |
| CFR | Code of Federal Regulations |
| COC | Contaminant of Concern |
| EE/CA | Engineering Evaluation/Cost Analysis |
| EPA | United Stated Environmental Protection Agency |
| FS | Forest Service, Intermountain Region, Uinta National Forest |
| NFS Lands | National Forest System Lands |
| ORV | Off Road Vehicle |
| ppb | Parts per billion |
| ppm | Parts per million |
| PRP | Potentially Responsible Party |
| PA | Preliminary Assessment |
| PRG | Preliminary Remediation Goal |
| QA/QC | Quality Assurance/Quality Control |
| SAIC | Science Applications International Corporation |
| SLB&M | Salt Lake Base & Meridian |
| TBC | To Be Considered |
| TCLP | Toxicity Characteristic Leaching Process |
| TCRA | Time Critical Removal Action |
| UDWQ | Utah Division of Water Quality |
| UDEQ | Utah Department of Environmental Quality |
| USBR | U.S. Bureau of Reclamation |
| USDA | United States Department of Agriculture |
| XRF | X-ray Fluorescence |

### Chemical Abbreviations

| | |
|---|---|
| As | Arsenic |
| Cd | Cadmium |
| Cu | Copper |
| Fe | Iron |
| Pb | Lead |
| Zn | Zinc |

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# 1.0 INTRODUCTION

This engineering evaluation and cost analysis (EE/CA) presents the results of an environmental investigation and engineering study conducted for a series of mining related sites in the American Fork Canyon (AFC) located on lands in private ownership under, or partially under the control of Mr. Dick Bass or Snowbird Corporation. The EE/CA was prepared to address a removal action proposed by Trout Unlimited of Arlington, Virginia to evaluate alternatives for mitigating environmental problems associated with the mines and recommends the preferred removal actions. The removal action was proposed by Trout Unlimited and supported by the land owners after the Forest Service completed a 2003 removal action in AFC. That action created a permanent repository on National Forest System lands at Dutchman Flat which contain mining, milling, and smelting wastes, all of which were removed from five operational units on National Forest System lands. The locations addressed in this EE/CA are releasing, or have the potential to release, hazardous substances into the environment on private and public lands and waters including the North Fork of American Fork River. These potential releases could potentially diminish the improvements to water quality and aquatic habitat achieved under the Forest Service removal action.

The removal action on private lands will complement the Forest Service project and share the same objectives of:

1. Minimizing the leaching of metals from wastes;
2. Minimizing human inhalation and ingestion of airborne dust particles containing lead;
3. Minimizing uptake of metals by wildlife edible plants and concentration in animals;
4. Reducing exposure of the waste piles to run-on and infiltration of meteoric waters.
5. Preventing mine drainage from contacting wastes and further leaching waste piles.
6. Removing wastes deposits from the riparian zone of American Fork River.

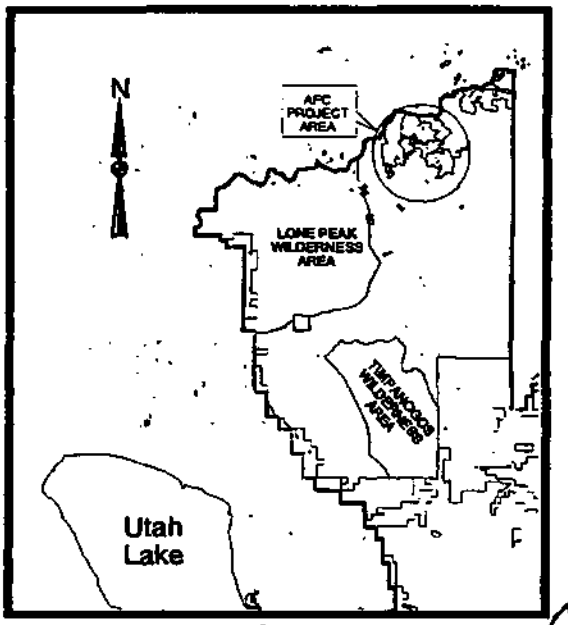
The EE/CA process has been designed to comply with the guidelines of the National Oil and Hazardous Substances Contingency Plan (NCP) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The EE/CA has been prepared in accordance with the U.S. Environmental Protection Agency (EPA) guidance for conducting non-time critical removal actions under CERCLA and is consistent with requirements in 40 Code of Federal Regulations (CFR) 300.415(b)(2)(i)-(viii).

## 1.1 SCOPE OF THE EE/CA

This EE/CA covers the mining and mill sites shown on the Project Location Map, Figure 1. The sites are:

- Pacific Mine Waste Rock Pile (Pacific Mine)
- Pacific Mill Site (Pacific Mill)
- Blue Rock Mine Waste Rock Pile (Blue Rock)
- Scotchman No. 2 Mine Waste Rock Pile (Scotchman)

# AMERICAN FORK CANYON
# MINE RECLAMATION PROJECT
# PROJECT LOCATION MAP




PITTSBURG LAKE

PACIFIC MINE

Miller Hill

DUTCHMAN FLAT

WILD DUTCHMAN

SILVER LAKE

SULTANA SMELTER

BAY STATE

FOREST LAKE

SILVER LAKE FLAT RESERVOIR

1 0 1 2 Miles

LOAN PEAK WILDERNESS AREA

UINTA NATIONAL FOREST

TIBBLE FORK RESERVOIR

FIGURE 1

## 1.2 PROJECT HISTORY

The following depicts studies conducted at the sites over the past several decades leading up to the recommended removal actions:

- 1985, Ben Albrechtsen, Forest Service Intermountain Region Mine Reclamation Specialist, visits Pacific Mine and recommends Uinta N.F. initiate investigations and reclamation.

- 1988, Lavere B. Merritt, *Preliminary Survey of Water Quality in Mine Drainage in Sheeprock Mountains and North Fork of the American Fork River.*

- 1988, Fred Mangum, *Aquatic Ecosystem Inventory Macroinvertebrate Analsis; Progress Report, Uinta National Forest*

- 1992, Pacific Mine was listed on the State of Utah CERCLIS

- 1992, Nancy, Kastning-Culp, University of Wyoming, *Year End Report on Mitigation Systems for Hard Rock Mine Effluent in Utah.*

- 1992, Lidstone & Anderson, Inc., *American Fork Hydrology and Water Quality Study* prepared for Utah Division of Oil, Gas and Mining. Purpose was to determine if toxic levels of trace metals are present in mine waters, and if an adverse impact to area streams or aquatic life can occur.

- 1993, Richard Crosland and Charmaine Thompson, *Heritage Resource Inventory of American Fork Area, Mine Closures, Utah County, Utah*

- 1994, a Preliminary Analysis of the sites was completed for Bog Mine, Pacific Mine, and the Mary Ellen Gulch Mines.

- 1998, Stephen Klassen, MS Thesis, Utah State University, *An Investigation of Plant Specific Native to the Intermountain West for Use in the Phytoremediation of Lead in Contaminated Soils.*

- 1998-1999, the watershed was funded under the Clean Water Action Plan Abandoned Mine Land Watershed Initiative. At that time, the forest hydrologist, Bob Gecy, conducted a series of soil, water, fish, and macroinvertebrate sampling. The hydrologist also installed shallow groundwater wells at the Pacific site and monitored water quality and soil chemistry in the tailings.

- 1999, the U.S. Geological Survey conducted a two-phase tracer study of the watershed to characterize the surface waters geochemistry and volume. The first study was on the North Fork of American Fork River, the second on Mary Ellen Gulch.

- 1999, Ted Fitzgerald was appointed On-Scene Coordinator for the mining sites in the watershed.

- 2000, TechLaw, Inc., *Potentially Responsible Party Search, American Fork Canyon Mine Sites*; and *Supplemental Potentially Responsible Party Search, Dutchman Flat Mine Site*. Subsequently, PRP negotiations have been on-going at the only site with viable PRP's, Pacific, where the PRP's are partial owners of the site.

- In 2000, a Community Relations Plan was developed to describe the efforts to be taken to involve other Federal, State, and local agencies in this project and how to inform the public about the pending actions at Pacific Mine and other sites in American Fork Mining District. Letters were sent to elected officials on February 25, 2000 alerting them to these pending actions. Forest Representatives met with the Utah County Council of Governments on March 2, 2000 to inform County Commissioners and Mayors of the hazardous materials concerns in American Fork Canyon and actions that were developing directed at correcting those problems. On March 7, 2000 Forest Service officials met with representatives of the Utah Division of Water Quality, Utah Division of Wildlife Resources, and Utah County Department of Health and presented them with the data that had been collected in American Fork Canyon. They were subsequently asked to review the data and determine the significance of that information pertaining to public health and welfare. A mass mailing of letters to Forest Users was done alerting them to the need for remedial actions in American Fork Canyon and the anticipated efforts that would occur in the near future.

- 2000, Environmental Protection Agency enters negotiations with the Forest Service to address the wastes on private property contributing to the contamination from heavy metals in AFC.

- 2000, A Time-Critical Action Memorandum was completed for Pacific in order to construct physical barriers to prevent recreational vehicle use of the Pacific tailings, due to high heavy metal concentrations, and to reduce exposure to ingestion and inhalation of blowing dusts.

- 2000, USDI, Bureau of Reclamation, Provo Area Office (USBR) under terms of an Interagency Agreement with the Forest Service, conducted Site Investigation topographical surveys, waste characterization studies, and installed ground water monitoring wells at Pacific, Dutchman Flat, and a proposed repository location. X-ray Fluorescence (XRF) investigations of metals in waste rock piles, tailings, mill sites, and the smelter site were conducted at Pacific, Dutchman Flat, Wild Dutchman, Sultana Smelter, and Bay State. Most of the other mine waste rock piles on NFS Lands in the American Fork Mining District were also tested with the XRF. *American Fork Canyon Watershed Reclamation Project, A preliminary Report, November 2000.*

- 2000, Forest Service installed monuments along the streams in AFC marking surface water monitoring stations. A comprehensive water monitoring effort was conducted at these stations by the Forest Service to establish current water quality baselines. These stations will be used for monitoring after the removal action to determine changes in water quality.

- 2000, Dr. Fred Magnum conducted two macroinvertebrate sampling efforts in July and September duplicating the sampling effort he performed in 1988. The samples were sent to Utah State University laboratories for testing and classification.

- 2001, Forest Service crews installed a post and pole fence (barrier) and sign at Dutchman Flat to prevent vehicle access to the site to reduce public exposure to heavy metals.

- 2001, Forest Service crews installed a rock barrier and sign at Sultana Smelter to prevent vehicle access to the site to reduce public exposure to heavy metals.

- 2001, Forest Service conducted a field review of the site with EPA, USBR, and others to confirm plans and expectations for removal actions at the site in 2002. The proposed repository was abandoned as a disposal site for the waste materials because of the high water table documented there this spring. The repository was moved to the bench at Dutchman Flat where no groundwater has been found within 20 feet of the surface.

- 2001, Science Applications International Corporation (SAIC), completed a Watershed Restoration Evaluation. In the evaluation, SAIC considered human health and ecological risks associated with the mine sites, recreational use, roads, and campgrounds, and formulated watershed restoration management alternatives and recommendations in the watershed. It did not address the listed CERCLA sites in its study, which were treated separately.

- 2001, USBR conducted additional topographical surveys at Wild Dutchman and at Dutchman Flat to include the area needed for the repository. Three more soil test pits were dug at this site to characterize the soils and to install three more ground water monitoring wells.

- 2001, Forest Service conducted Land Line Surveys to establish the property boundary between private and NFS Lands at Dutchman Flat, Wild Dutchman, and adjacent properties.

- 2001, Forest Service conducted a "Show Me Trip" for prospective contractors to acquaint them with the work to be done under contract in 2002. This was done at this time to allow advertising for proposals from prospective contractors during the winter months of 2001-2002.

- 2001, In November the EPA notified the Forest Service that due to the "911" attacks on the United States of America and the anthrax assault their priorities had been redirected and they would not be in a position to participate in a removal action in American Fork Canyon in the foreseeable future. They advised the Forest Service to proceed with removal actions on NFS Lands as our funding and opportunities developed.

- 2002, Forest Service and USDA abandoned the Time Critical Removal Action strategy for AFC supported by EPA and reverted to preparation of this EE/CA for a Non-Time Critical Removal Action to begin in 2002.

- 2002, Utah Division of Water Quality notified the Forest Service that the North Fork of American Fork River will be listed as a 303(d) impaired water by the State of Utah in 2002. Forest Service met with State and local agencies to formulate plans for the State to issue a Fish Advisory advising the public to not consume native fish (browns and

- **Section 3.0 Site Investigation** reviews the various sampling and testing efforts undertaken to determine the extent of the contamination at each site and the pathways the contaminants follow to affect receptors.
- **Section 4.0 Applicable or Relevant and Appropriate Requirements** discusses Federal and state regulations and criteria considered in cleanup goals.
- **Section 5.0 Streamlined Risk Evaluation** compares contaminant levels with both human health and ecological health criteria.
- **Section 6.0 Removal Action Objectives (RAOS)** sets out the objectives of this cleanup action in American Fork Canyon.
- **Section 7.0 Identification and Preliminary Screening of Removal Action Technologies** includes a brief overview of the removal objectives for the site, and screens those alternatives that would not be practical for this action.
- **Section 8.0 Removal Action Alternative Evaluation** discusses an analysis of those alternatives under serious consideration and a comparison of each viable alternative's effectiveness, implementability, and cost.
- **Section 9.0 Bibliography** lists other documents referenced in preparing this EE/CA.

## 2.0 SITE PHYSIOLOGY AND SITE SPECIFIC DESCRIPTIONS AND HISTORY

### 2.1 GENERAL SITE PHYSIOLOGY

The project area is located adjacent to the North Fork of the American Fork River, American Fork Canyon, Utah County, Utah at an elevation of about 7,800 feet. The project sites are in Section 22, T3S, R3E, SLB&M. The project considers the treatment of mining and milling wastes at Pacific Mine, Pacific Mill, Blue Rock, and Scotchman.

#### 2.1.1 Location and Access

The primary access to the North Fork is from State Highway 92 that traverses the Forest from American Fork City on the West to Provo Canyon on the East (Highway 92 includes the Alpine Scenic Highway). Forest Development Road 085 accesses the North Fork starting at a junction with U-92 five miles from the Forest Boundary up American Fork Canyon and 3 miles past Timpanogos Cave National Monument. FDR 085 is paved for 2 ½ miles to Tibble Fork Reservoir. From there the road is maintained at a gravel standard for about two miles and then continues as a primitive road to the project site another 5 miles to Pacific Mine. The road is not recommended for sedans (low clearance vehicles) and trucks with trailers beyond the gravel section. *(See Exhibit 1: Project Location Map).*

The project can also be accesses from the Northeast and the Heber City area, near Deer Creek Reservoir and through Wasatch Mountain State Park. This route involves many more miles of unimproved roads and requires crossing a mountain ridge at near 8500 feet in elevation at Pole Line Pass. This road is not considered a suitable access for construction operations tied to this project.

#### 2.1.2 Site Features

This project includes 3 historic mining sites and a mill site in the American Fork Mining District in the Mineral Basin area. The mines are Pacific Mine, Scotchman No. 2, and Blue Rock. An additional site included in this project is the Pacific Mill. Mining features found at the sites include waste rock dumps, plugged adits, and a mill site consisting of crumbling concrete foundations and contaminated soils. Also, some concrete pillars and foundations, and timber cribs are found at the work sites. Remnants of old buildings (none standing) and their foundations are evident near Pacific Mine on private property within the project area.

#### 2.1.3 Land Use and Population

The nearest communities to the site are American Fork and Alpine cities, located approximately 14 miles to the west of the area. Snowbird Ski Resort and Alta are the closest residential housing to the project located in Little Cottonwood Canyon three miles north of Pacific Mine, but is separated from the project area by Sugarloaf Mountain.

American Fork Canyon has over 1.2 million visitors pass through fee collection stations on the Alpine Scenic Highway each year. The majority of those visitors live in Utah Valley or in the cities to the north along the Wasatch Front. The vast majority of use in the canyon by these

visitors is recreation oriented. It is estimated that less than 5% of the people in the canyon venture up the North Fork to the project area.

Recreational use in the project area includes motorized sight seeing, ATV and Jeep riding, fishing, exploring mine sites, picnicking, hiking, camping, hunting, and horseback riding. Heavy use is made of the streams and old mine sites. The Uinta National Forest completed its Land and Resource Management Plan in 1984 and updated and released again it 2003. The Site falls within the Pleasant Grove Management Area #2. The Plan states that population increases nearby will place increased demand on the area. Recreation-related activities will probably be the major use. The portion of the site administered by the Forest Service is predominantly designated for dispersed recreation opportunities but use of motorized recreational vehicles is managed in accordance with the Uinta's Travel Management Plan. For the most part, recreationists cannot differentiate between the public land managed by the Forest Service and the adjacent private properties in the canyon. There are very few signs identifying the property boundaries and the public continues to use the private property just as it does the public lands. However, land owners could at any time place restrictions on the uses allowed on their properties and could discontinue public access to the private lands in the canyon.

Notable tourist attractions are the historic mining landscape of the area amidst the scenic beauty of the canyon, backcountry exploring and wildlife viewing, and the large skiing recreational use being continuously developed in the area. In 1999 and 2001, ski runs and lifts were constructed in the headwaters of the North Fork of American Fork Canyon by Snowbird Ski Resorts, 2 miles up canyon from Pacific Mine. These lifts are accessed from facilities in Little Cottonwood Canyon at Snowbird and Alta.

### 2.1.4 Vegetation and Wildlife

The watershed is defined topographically as high, rugged alpine peaks and lakes in cirque basins, steep to moderately steep timbered slopes, narrow canyon bottoms and brush/grass covered slopes and ridges. The watershed ranges in elevation from 6,000 feet to 11,000 feet. The vegetation types in the area are aspen, spruce/fir, dry and wet meadows vegetation, subalpine and alpine herblands. The canyon's vegetation includes a riparian community along the river and major tributaries that includes cottonwood, box elder, and willow, the latter being dominant at the high elevations. The canyon slopes are covered by a mixed conifer forest, with oak and maple at the lower elevations, and aspen clones higher up. Above 10,000 feet alpine tundra begins, with low shrubs, grasses and herbs.

The area provides habitat for elk, mule deer, bighorn sheep, Rocky Mountain goat, black bear, moose, mountain lion, marmot, and abundant beaver. The river is important spawning and rearing streams for Bonneville cutthroat trout (a sensitive species), brown and rainbow trout.

### 2.1.5 Historical and Archaeological Features

An archaeological survey was completed in 1994 to determine the historical and archaeological significance of the various mining site features in American Fork Canyon. The study was conducted as a NEPA requirement in order for the Utah Department of Natural Resources, Division of Oil, Gas, and Mining, to conduct safety closures of unsafe mine openings in the watershed. Numerous mine site features were determined to be eligible for listing in the

National Register of Historic Places (NHRP) in a June 8, 1994, report entitled "*Heritage Resource Inventory of American Fork Area Mine Closures, Utah County, Utah*".

In the report, the entire Pacific site including the Blue Rock Mine was considered eligible for the NRHP because of its structural features, potentially buried deposits, and the major role that the mill played in the history of the American Fork Mining District. The Scotchman site was considered to be ineligible because it contained little potential to yield additional historical information. Although the Pacific site was primarily on private land, the Forest Service has mapped and recorded the surface features of this site to preserve record of this historic site in American Fork Canyon. Disturbance of the site during removal actions will obliterate and remove a substantial amount of the existing surface features but the record developed by the Forest Service will preserve the historic significance of the site.

### 2.1.6 Climate

The climate of the canyon is heavily affected by its elevation and topography. Winter precipitation is generally heavy, and the shadowy lower canyon can be snow-bound well into the spring. Portions of the upper canyon remain under snow until mid-July or August. Half a dozen peaks in the watershed area have elevations that approach or exceeds 11,000 feet. The project area lies in the canyon bottom with elevations of about 7,800 feet. Steeply sloping ridges and summits with narrow inter-mountain glacial valleys dominate the area. The annual average precipitation is 50 inches, mostly in the form of snow in the winter months and snow and rain and in spring and fall.

### 2.1.7 Topography, Geology and Soils

The topography of the American Fork canyon area is characterized by strong relief, with a narrow canyon bottom and high, steep canyon walls. Elevation at its mouth is near 5,000 feet, with a dramatic rise to 11,489 feet at Twin Peaks, on the ridge between American Fork and Little Cottonwood canyons. The canyon itself was formed during up-warping of the Wasatch Range, with the details of its present topography greatly influenced by glaciers during the Quaternary period. The steep canyon sides, areas of polished, bare rock, and deposits of "drift" all date from this era. The head of the canyon, called Mineral Basin, is a large, steep-sided cirque. Its principle side drainages, including Major Evans and Mary Ellen Gulch, are "hanging" canyons, with narrow mouths choked with glacial debris.

The formations of the Cottonwood-American Fork mining area have been documented in some detail because of its mineral production. The area is an interesting segment of the Wasatch Range because it is in direct line with the powerful anticline of the Uinta Range. Its structure, therefore, contains both the north to south trending folds and thrusts of the Wasatch Range as well as large intrusive bodies from the Uinta Range. In addition, pressure from the Uinta anticline has produced very complex structure, with unconformities, metamorphism, and striking overthrust faulting. This geologic dynamism may account for the fact that this area has been the only highly productive mining area along the Wasatch Front.

Limestones and quartzites from the Mississippian and Cambrian Eras form much of the striking visible topography of the area, and are home to some of the most productive ore bodies in the canyon. These, and the other sedimentary rock layers (including shale, conglomerate, dolomite, and tillite) which dominate the Cottonwood-American Fork area, contain three large

masses of intrusive igneous rock. These are aligned east to west in a line between the crest of the Uinta Mountains to the east, and the Oquirh Mountains to the west, and occur north of American Fork Canyon. However, smaller extensions of these reach into the canyon. Igneous dikes occur at the heads of Miller Hill, and on the west side of Dry Creek extending east through the ridge to the head of Snake Creek.

The most active fault zone in American Fork Canyon is at Miller Hill, where at least six significant faults have produced very complex rock structures. An overthrust fault northwest of Miller Hill, on the divide between American Fork Canyon and Mary Ellen Gulch, has created the unusual situation of older rock beds over younger ones. Other nodes of structural complexity occur three quarters of a mile east of Pittsburg Lake and near the mouth of Dry Creek. The Yankee, Globe, and Silver King mines are all associated with faults in Mary Ellen Gulch, and at least two faults occur in Major Evans Gulch, one noted in the Earl Eagle mine shafts, and another associated with Bay State mine. A significant fault also trends across Dutchman Flat, and has several mines on or adjacent to it.

The upper American Fork area is crossed by numerous faults, including the Silver Fork Fault near Mineral Flat, the Pittsburg Fault near Pittsburg Mine, the Dry Fork Canyon Fault, several faults in the Miller Hill area, Dutchman Fault, and the one most important to this project, the Pacific Fault.

Mineral deposits in the canyon occur largely in fissures originally created by stratigraphic processes and faulting. These fissures were then enlarged by the mechanical and dissolving action of water, which in turn deposited minerals passing through the rock. In this way, several different kinds of minerals (including gold, silver, lead, copper and zinc) were left in the fissures, and acted upon by contact with pressure, other minerals, and oxygen to produce the ore bodies targeted by miners.

All the economically important ore bodies occur in the sedimentary rocks of American Fork Canyon. However, all these are also associated with intrusions of igneous rock, since they provide many of the minerals that water leaches, and then deposits in fissures. The most productive deposits – including the spectacular finds on Miller Hill during the early mining period – are beds of limestone adjacent to cross-cutting fissures which have been replaced by mineralized ores. In addition, metamorphic alteration of limestone and dolomite by contact with igneous dikes creates a low grade ore that has been mined in the area with modest results.

Further, ore bodies tend to concentrate in areas where faulting has produced more fissures. Locating and mapping fault lines is important to miners for other reasons, as well. The same faulting that created the fissures for the ore bodies can, after their deposition, move and conceal segments of them in very confusing ways. On the other hand, overthrust faults can repeat rock layers that contain ore bodies on top of each other, increasing a mine's potential for success. Also, movement along thrust faults tends to crush and brecciate adjacent rocks, which become more favorable places for ore development.

### 2.1.8 Hydrogeology

Pacific Mine is located on the uplands just above the riparian zone of the North Fork of American Fork River. Numerous springs and seeps are found at lower elevations around the waste rock piles and tailings. The adit at Pacific Mine discharges approximately 450 gallons

per minute. This indicates that the mine workings intersect the groundwater table. Test drill holes and ground water monitoring wells in the project area shows highly varying groundwater depths. Some wells in the flood plain of the river display water as close as one foot to the surface while another well near the adit within the perimeter of the proposed repository is dry at 20 feet. Deeper groundwater is likely confined in a fracture flow system in the underlying intrusive bedrock. The presence of springs near the reclaimed tailings pond indicates that the groundwater table intersects the surface in this area, some 30 feet lower in elevation than the waste rock pile and proposed repository at Pacific. The hillside where the Pacific Mill was located is a steep dry slope. Any releases from this site occur during runoff from heavy precipitation events.

The Scotchman No. 2 adit is approximately 40 feet above the stream elevation. No water is being released from this adit. The Miller Hill access road runs between the adit and the waste rock pile providing good access to the site. The waste rock pile cascades down the hillside with the toe of the pile butting up to the water in the river. Any runoff from this site goes directly into the river.

The Blue Rock mine is about 50 feet higher in elevation than Pacific mine and is located on the flanks of a side canyon less than 1/8 mile up canyon from Pacific. The waste rock pile runs down the hillside from the adit to the bottom of the side drainage. Only intermittent flows occur in this drainage so erosion from the site and at the toe of the waste rock pile coincides with precipitation events.

### 2.1.9 Surface Water Hydrology

This area of the Wasatch Mountains is drained almost wholly by three streams of general westerly course. The two Cottonwood Creeks (Little and Big), entering the Jordan River near Murray, and the American Fork which flows into Utah Lake. The American Fork has two main forks, the North Fork and the South Fork. The North Fork produces about triple the flow of the South Fork. The North Fork has one main tributary in Mary Ellen Gulch, which flows southeastward from the Twin Peaks. The ridgeline between Little Cottonwood and American Fork canyons is the most rugged in the area, and it bears half a dozen peaks whose elevations approach or exceed 11,000 feet. The highest of these in this area are the Twin Peaks at 11,491 and 11,434 feet.

All of the subject sites are located along the North Fork of American Fork River. The following flow rates (cubic feet per second) were measured in 2000 during water monitoring tests performed by Uinta National Forest personnel:

- North Fork at Pacific — June = 28 cfs — July = 2.1 cfs
- Pacific Adit Discharge — June = 0.9 cfs — July = 1.4 cfs
- Mary Ellen Gulch (MEG) — June = 14 cfs — July = 1.5 cfs
- North Fork below MEG — June = 45 cfs — July = 7.6 cfs
- North Fork at Tibble Fork — June = 60 cfs — July = 25 cfs

The flow in the river varies greatly from year to year depending on weather cycles (wet periods or sustained drought) and snow pack. In 2000 this area was experiencing its second year of low snow pack and drought. The drought has continued through 2004 but high temperatures in May of 2003 created flood waters from snow melt that breached established stream banks

and washed out virtually all the beaver dams in the river. Some of the dams were rebuilt by the beaver in the fall of 2003 and new dams appeared in the fall of 2004.

## 2.2 DESCRIPTION OF THE SITES AND THEIR HISTORIES

### 2.2.1 Pacific Mine, Pacific Mill, and Blue Rock Mine Sites

#### 2.2.1.1 Site Description

The Pacific mine and mill Sites are located on the Blue Rock No. 2 mining claim (patent). The Blue Rock mine is on the Blue Rock (No. 1) mining claim. These claims and patents have common ownership patterns and histories. Reference hereafter to Pacific mine generally includes the Blue Rock mine with regard to ownership.

The Pacific Mine is located at an elevation of 7,750 feet, adjacent to the North Fork of the American Fork River, American Fork Canyon, Utah County, Utah. *(See Project Site Map – Figure 2)* It is in Section 22, T3S, R3E, SLB&M. The Pacific Mine was docketed by the Environmental Protection Agency (EPA) on it's Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) on January 24, 1992, based on water quality and macroinvertebrate data collected by or for the Uinta National Forest in 1988. The Pacific Mine was determined to be eligible for listing in the National Register of Historic Places in a June 8, 1994 report entitled *"Heritage Resource Inventory of American Fork Area Mine Closures, Utah County, Utah"*.

The Pacific Mine was characterized by a waste rock and tailings pile (tailings were removed by the Forest Service in 2003), adits that have been closed with native soils and rock but are producing mine drainage, concrete pillars and foundations, and timber cribs. *(See Figure 4 Pacific Mine Conceptual Site Flow Diagram in Section 8 of This Document)* The site still has the mill foundation, consisting of a series of concrete pylons and walls built up the face of a steep slope. A massive waste rock pile of approximately 35,000 cubic yards exists with partially intact loading docks and ore chutes. There are also roof and wall fragments from six of the houses/offices used by the Pacific Gold Milling and Mining Company. The foundation and basement for a bunkhouse is also present on the site.

Also included with this Pacific complex is the Blue Rock mine, located just north of the main portion of the mine and historically a part of its operation. Blue Rock also has some structural debris and a rock retaining wall at its mouth. The adit was closed with a concrete block barrier. The waste rock pile contains about 3,000 cubic yards of waste rock. A timber crib loading chute still exists at the lower edge of the waste rock pile. There is a mountain cabin at the base of the waste rock pile with the timber crib forming one of the walls of the cabin. As late as 2001 the cabin was still in use without the knowledge of the land owner. When they learned of this use the people maintaining the cabin were told to vacate the site. Since then the cabin has been vandalized and the land owner plans to demolish the cabin and timber crib during the removal action operations.

The Pacific site is partially on private property and partially on NFS Lands. The adits, historic constructed features, and waste rock piles are predominantly on patented (private) lands while the tailings and a small waste rock pile were located in trespass on NFS Lands. The NFS lands were cleaned of all the waste materials during the 2003 removal action. Water quality sampling, Macroinvertebrate inventories, soils analyses, sediment sampling, and fish tissue

# AMERICAN FORK CANYON
# MINE RECLAMATION PROJECT
# PROJECT SITE MAP

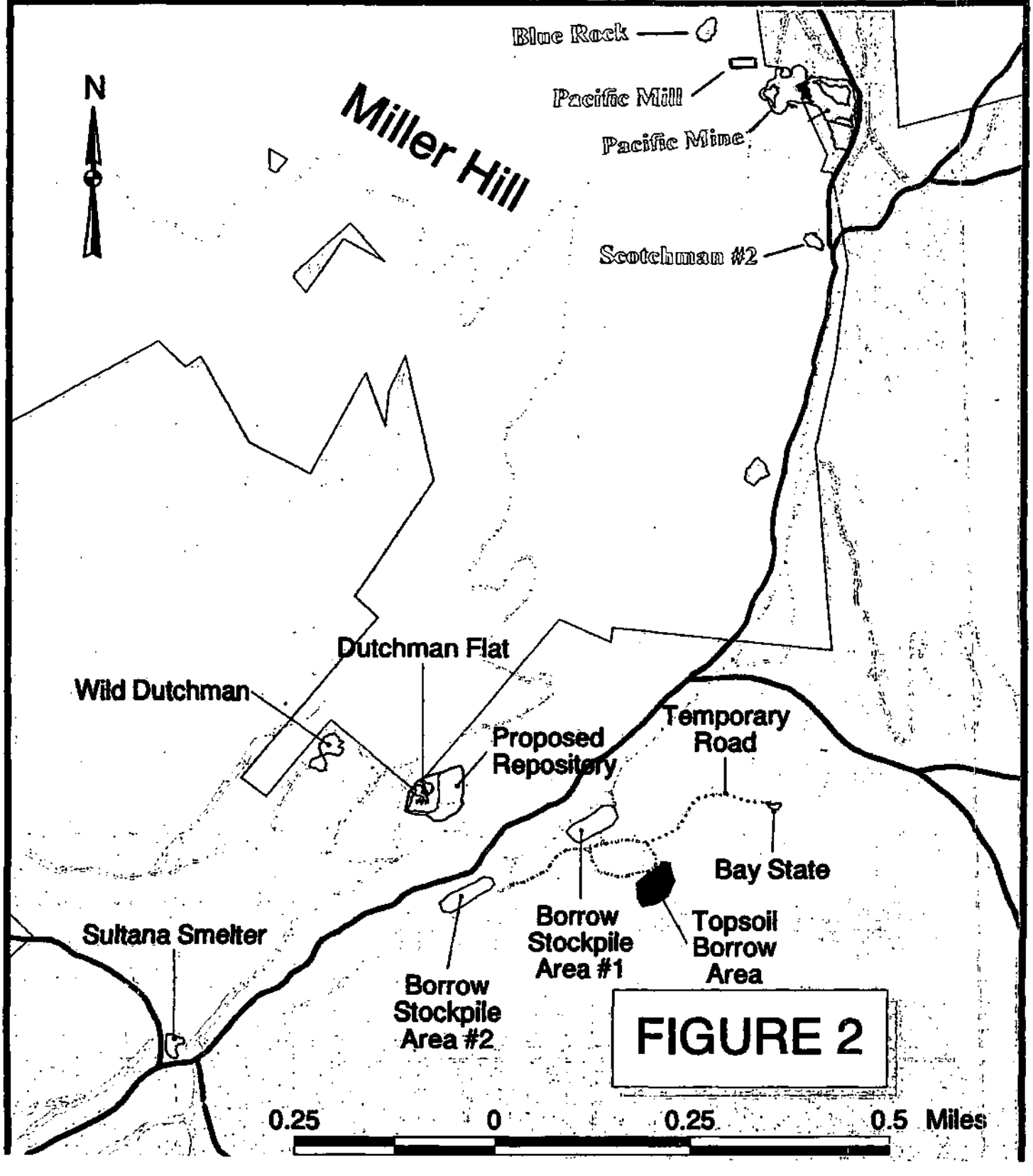



FIGURE 2

sampling have identified the Pacific Mine as the site that historically exhibited and released the largest concentrations of hazardous materials in the American Fork Mining District. Before it was removed by the Forest Service, the tailings deposit impinged on the North Fork of American Fork River, in places forming the banks of the stream, and contained an abundance of heavy metals including lead at an average concentration of 17,000 parts per million (ppm), cadmium 44 ppm, copper 335 ppm, zinc 6,000 ppm, arsenic 165 ppm, barium 1850 ppm, and iron 14,000 ppm in the minus 4 soil fraction. The metal concentrations in the waste rock pile at Pacific are similar, though lower in concentrations, to those in the tailings.

The southeast adit is discharging mine drainage at an average flow rate of approximately 1 cubic feet per second, fluctuating seasonally. The discharge has a near neutral pH of 7.2 but contains concentrations of lead at 13 parts per billion (ppb) and zinc at 1330 ppb, along with various other heavy metals (2000 water quality samples). Before removal of the tailings, flows entering the river after running across the tailings pile were measured to increase in lead content from 13 ppb to 1,500 ppb while the zinc levels show minor change. Water monitoring test results obtained by the Forest Service in July 2004 showed the water discharging from the adit to have lead and zinc concentrations of <5 ppb and 2500 pbb respectively. The water from the ponds (future wetlands) created during removal and reclamation operations discharging into the river has lead and zinc concentrations of <5 ppb and 23 ppb respectively. However, these accomplishments remain in jeopardy as long as the potential exists for the discharge from Pacific Mine to come in contact with the waste rock pile and increase the chemical loading of the water. The proposed removal action will further separate and isolate the waste materials from the mine drainage thus protecting the accomplishments in water quality achieved thus far.

### 2.2.1.2 Site History

The Pacific Mine, Blue Rock Mine and Pacific Mill sites are located on the Blue Rock claims (patented) in the upper portion of American Fork Canyon approximately 1.5 miles above Dutchman Flat. The sites are the remains of a mining and milling complex, one of the largest and most successful in American Fork Canyon. Its extensive assembly of underground shafts was begun in the 1870s, but the largest developments at the site occurred about 1916 and 1917 when a concentration mill was erected. The site is actually on the Blue Rock claims and was known as such until acquired by the Pacific Gold Milling and Mining Company in 1904. The Blue Rock claims were located in 1902 by John Armstrong, James Chipman Jr., H.C. Johnson, and Joseph C. Burgess. The claims were patented in 1912 by the Pacific Gold Milling and Mining Company. Financial struggles led the company to repeatedly lease the mine to various parties through 1931. Blue Rock #2 was obtained at Tax Sales repeatedly by Utah County during this period and redeemed by Pacific Mining and Milling Company.

In 1916, the Pacific Gold property continued to be the principal producer in AFC. An electrically driven mill equipped with "2 sets of rolls, 2 trommels, Callow screen, 3 elevators, 2 roughing tables, 2 sand tables and 2 double deck slime tables", was erected and completed on the Pacific Gold property that year. The mill began operations during the latter part of December. The mill was described as a 65 ton concentration mill and was located at the portal of Dutchman tunnel. A 70 ton table concentrator was erected in 1916.

In 1917, the focus of activity in AFC shifted to "sensational discoveries" on the Blue Rock claim. The Pacific fissure was drifted upon for 700 feet. The Fissures Exploration Company, described as the owner of the property, carrying on "a vigorous and systematic plan of

development" discovered a good sized body of ore. The strike was described as the largest since the Miller mine.

The small mill erected to treat the lead ore from the Pacific property was replaced by a larger plant near the portal of the Blue Rock tunnel in 1917. This new mil was capable of treating 150 tons of ore per day. The equipment of the Pacific mill consisted of "one Blade crusher, one set of rolls, a Hardinge tube mill, four Deister cone classifiers, four Diester sand tables, and six double-deck Diester slimers." It is not clear which company was responsible for building the mill, although the USGS report for the year 1917 states that the Fissures Exploration Company increased its mill capacity in 1917, suggesting that the Fissures Exploration Company may have built the new mill.

Mining activity at Pacific was light and intermittent from 1918 to 1925. But in 1925, the Pacific or Blue Rock mine" produced 338 tons of lead-silver ore, which brought $27,270.55 at the smelter. "Mill ore amounting to 5,333 tons was placed on the dump preparatory to starting the concentrator at the mine." In 1925, the Salt Lake Mining Review reported that the Pacific Mill was the largest mill used in the District and could treat up to 900 tons pf ore per day.

In 1926, the Pacific Gold Mining Company treated about 2,000 tons of lead ore in a mill equipped for gravity concentration. In a November 1, 1926 statement to its stockholders, the Company stated that the mill was repaired and renovated and operated between June 28 and September 23. The concentrate was hauled 20 miles to a smelter at Murray, Utah. The Company also completed 600 feet of development in drifting and raising.

In 1929, the PACIFIC Gold Mining and Milling Company reconstructed the mill on its property and added flotation equipment. More than 2,000 tons of sulphide lead ore was treated in the 35-ton flotation plant and silver lead concentrates and two cars of first class ore were shipped to Murray for smelting.

Mining activity was documented at Pacific and Blue Rock until 1952. No records of further activity on the Blue Rock claims were located. A local account of the history of the area notes that the last shipment the author remembered being shipped from the old Pacific Mine was in about 1953. This account also notes that "the tailings ponds were well constructed to contain the waste and settle the sediment out of the water before it entered the main creek of American Fork River. The waste material from the mill operation was very good road material and was used extensively for road repair in those early years."

In 1931 title to the properties were transferred to T.H. Sumner dba Sumner Mercantile Agency. In 1932 Blue Rock Mining and Milling Company obtained title to these properties. This company entered into ownership agreements for the properties with American Fork Consolidated Mines. In 1956 American Consolidated Mines gained full title to the properties and later that year transferred them to East Utah Mining Company by Deed. In 1970, Richard D. Bass purchased the surface rights to these and other properties in American Fork Canyon. During the ensuing decade, the private property went through numerous ownership conveyances between Richard Bass and Robert G. Pruitt, and finally to Claron C. Spenser as Trustee for the Bass family trust. All mineral and deep mining rights for Blue Rock #2 were reserved by East Utah Mining Company. The mineral rights were transferred to Franco-Nevada Mining Corporation in 1986 who subsequently conveyed the rights to Euro-Nevada Mining Corporation.

Despite all these transactions, apparently no mining operations have occurred at the Pacific and Blue Rock sites since the 1950's. The individuals and companies that actually engaged in the mining and milling operations have either died or have been dissolved leaving the current surface land owner with the challenge of managing the waste deposits to prevent a release onto public lands and waters.

### 2.2.1.3 Current Status

After listing of the Pacific Mine on EPA's CERCLIS in 1992, the Uinta National Forest completed a Preliminary Assessment (PA) of Pacific Mine and other sites in the American Fork Mining District. Releases of hazardous substances and contamination of National Forest resources were confirmed through the PA that was completed in June 1994. The assessment considered the 1988 water quality and macro-invertebrate investigations and additional water quality sampling and testing done under contract by Lidstone and Anderson in 1992.

An attempt was made by the Utah Division of Oil, Gas, and Mining to reduce the quantity of hazardous substances being released into the North Fork of American Fork River in 1995. That effort consisted of constructing a limestone lined, open channel to divert mine discharge waters off the tailings pile into a wetland and beaver pond adjacent to the site. The effectiveness of the channel was short lived because it was compromised by the heavy ATV/motorcycle/jeep use made of this site by motorized recreationists. Prior to the 2003 removal action by the Forest Service most of the mine drainage was continuing to flow across (and within) the tailings pile before discharging directly into the North Fork of American Fork River. Presently the mine discharge is being diverted away from the Pacific waste rock pile by the reconditioned channel originally constructed in 1995 into a beaver pond. Overflow from the beaver pond runs through a series of ponds created by the Forest Service as the excavated and backfilled tailings pond was reclaimed.

Additional soils, water, and fish sampling was conducted in 1998 through 2001. All tests indicated and confirmed releases from Pacific Mine. The Intermountain Region contracted to have the Potentially Responsible Parties (PRP's) identified for some of the potential reclamation sites in American Fork Canyon in 1999. Letters were sent to PRP's requesting information about their involvement in the mining activities and ownership of the offending sites in the canyon. A meeting was held with a few PRP's involved with Pacific Mine. Additional PRP's were identified for the site and letters of discovery were sent to them.

The result of the Government's PRP investigations was that there were no viable PRP's responsible for participating in the removal of mining wastes from NFS Lands at Pacific Mine. The Forest Service completed reclamation of that portion of the site on NFS Lands under the authority delegated to the agency through CERCLA regulations utilizing the monies appropriated by Congress for treatment of Abandoned Mine Lands on Federal lands. The Forest Service coordinated its removal action with the EPA, the Utah Department of Environmental Quality (UDEQ), and owners of affected private lands but all removal actions were confined to NFS lands in 2003.

In October 1999, the Forest Supervisor and Regional Forester assigned Ted Fitzgerald to the position of On-Scene Coordinator for the American Fork Canyon Watershed Reclamation

Project. On January 24, 2000, a meeting was held between the Forest Service, Utah Division of Water Quality, and the Utah Division of Oil, Gas, and Mining. It was recognized by all the participants that the data that has been collected for Pacific Mine indicates closure of the site to recreational uses should occur as quickly as procedures would allow to reduce public exposure to potentially hazardous materials.

A Community Relations Plan was developed to describe the efforts to be taken to involve other Federal, State, and local agencies in this project and how to inform the public about the pending actions at Pacific Mine and other sites in American Fork Mining District. Letters were sent to elected officials on February 25, 2000 alerting them to these pending actions. Forest Representatives met with the Utah County Council of Governments on March 2, 2000 to inform County Commissioners and Mayors of the hazardous materials concerns in American Fork Canyon and actions that were developing directed at correcting those problems.

In reviewing land ownership in the watershed, the Office of General Council determined it appropriate to also involve the Environmental Protection Agency (EPA) due to the large amount of private land, as well as the Utah Department of Environmental Quality (UDEQ), and owners of affected private lands.

On March 7, 2000 Forest Service officials met with representatives of the Utah Division of Water Quality, Utah Division of Wildlife Resources, and Utah County Department of Health and presented them with the data that had been collected in American Fork Canyon. They were subsequently asked to review the data and determine the significance of that information pertaining to public health and welfare. Utah County's Health Department letter of May 1, 2000 states,

> "Concerning the Pacific Mine tailings, we would recommend posting and/or fencing the area to exclude recreational ORV riders from further disturbing the site. We would also recommend posting other potentially hazardous mine tailing sites in the north fork to help prevent airborne dust from further contaminating the air and water near these sites."

On March 28, 2000 a mass mailing of letters to Forest Users alerted them to the need for removal actions in American Fork Canyon and the anticipated efforts that would occur in the near future.

In a January 18, 2000 memorandum to the Forest Supervisor from Uinta National Forest's Hydrologist, Bob Gecy, recommendation was made to close the Pacific Mine to recreational use. His concerns centered on the high levels of contaminants at the site that could become air borne dust occurring naturally, or caused from ATV riding, that could be inhaled at concentrations hazardous to human health.

A CERCLA Time-Critical Removal Action was necessary to reduce exposure of Forest visitors to airborne lead particulates, and the release of heavy metals leached from the tailings pile into the environment in the vicinity of Pacific Mine and downstream in the North Fork of American Fork Canyon. A Time-Critical Removal Action Memorandum was completed and signed by the Regional Forester on June 5th, 2000, and published for a 30-day comment period. The Action Memorandum proposed the following actions:

1. Notifying the public of the closure, and purpose therefore, through media releases and signing at the site.
2. Constructing and maintaining physical barricades to block all access points for motorized vehicles to the NFS Lands at the site. Maintain signing at the site to explain the need for the closure.
3. Repairing the previously constructed channels to prevent mine drainage from flowing across the tailings deposits.
4. Coordinating efforts with the EPA, the UDEQ, and owners of affected private lands to adequately protect human health and the environment.

The removal (closure) action was completed in the fall of 2000 with guardrail type barriers installed at all access points on NFS Lands to the wastes at Pacific Mine. Signs were installed to explain the purpose for the closures and notifying the public that access to the sites was restricted to reduce the public exposure to potentially hazardous materials.

In 2001 Snowbird Ltd., acting on behalf of Richard D. Bass, installed additional barriers on the private portion of this site to prevent vehicular access to the wastes piles. Some work was done to redirect the drainage from the mine adit away from the waste rock piles and tailings but more effort is needed to permanently channelize these waters.

In 2003 the Forest Service issued a contract to Granite Construction of Heber, Utah for the removal of the mill tailings at Pacific and a small waste rock pile, all of which were on NFS lands. No action was taken concerning the larger waste rock pile on private property at Pacific. The contract called for the construction of a permanent repository at Dutchman Flat. The Pacific wastes were consolidated with waste from 4 other sites on NFS lands at this repository.

The mill tailings pond was backfilled after excavation of the tailings and reclaimed. The reclamation included the establishment of 6 shallow ponds that will eventually become a wetlands environment. The mine drainage from the Pacific adit runs through these ponds after discharging from a beaver dam. At this point the ponds function primarily as settling ponds but willows have been transplanted to the perimeter of the ponds and other wetland vegetation is already becoming established in the ponds. Eventually this aquatic vegetation will serve to sorb metals from the water further reducing the metal loadings reaching the river. The ponds also serve to intercept any runoff and contaminated materials released from the Pacific waste rock pile and prevent it from going directly into the river.

There remains a concern about the stability of the pipes and channel that transport the mine drainage at the Pacific adit away from the remaining waste rock pile. The water is released from the plugged adit by two 6 inch diameter pipes. The water runs overland for about 6 feet where it then enters a 12 inch pipe carrying the water some 40 feet under the present Miller Hill access road. Vandals could easily plug or block the 12 inch pipe causing the mine drainage to run overland and seek its own channel. Historically that natural path for the drainage was along the northern toe of the waste rock pile. The water discharging from the mine should be contained in a pipe connecting the two 6 inch pipes with the 12 inch pipe and that pipe buried to prevent possible vandalism and increased erosion of contaminated materials.

### 2.2.2 Scotchman No. 2 Mine

#### 2.2.2.1 Site Description

The Scotchman No. 2 mine is ¼ mile down canyon from Pacific mine. This was a small mining operation that produced about 1000 cubic yards of waste rock. The adit is approximately 50 feet above the stream elevation. No water is being released from this plugged adit. The Miller Hill access road runs between the adit and the waste rock pile providing good access to the site. The waste rock pile cascades down the hillside with the toe of the pile butting up to the water in the river. Any runoff from this site goes directly into the river.

#### 2.2.2.2 Site History

The Scotchman No. 2 Mine was located on October 1, 1907. The Patent for Scotchman No. 2 and other claims was issued on January 19, 1914, to Miller Hill Mining Company. Miller Hill Mining Company appears to have acquired the claim from J.C. Jensen, Agnes M. Jensen, J.F. Noyes, and others by Quit Claim Deed on December 29, 1908. At various times Utah County acquired title to this property due to Tax Sales but the property invariably was redeemed by Miller Hill Mining Company. There were a series of leases for the property to several entities between 1918 and 1948 but the principle owner remained the Miller Hill Mining Company. More recently in 1976, Miller Hill Mining Company (Lessor) entered into an Oil and Gas Lease with Odessa Natural Corporation (Lesseee) covering certain property including Hot Stuff, Scotchman #2, and other claims. According to the 1999 Utah County land status records, Miller Hill Mining Company was still the owner of this property. In 2004, Snowbird Corporation reported having entered into agreements which enable them to negotiate right of use and restoration actions on this property.

#### 2.2.2.3 Current Status

The adit has been plugged by caving of the overlying rock and soil. Without the waste rock pile the presence of this historic mine would be noted only by those individuals knowledgeable about the mining history of AFC. The waste rock pile lies on the westerly slope of the hillside and stream bank of the river. The main access road to Mineral Basin and the North Fork is approximately 100 feet east of the waste rock pile. The river runs between the waste rock pile and the road. A very popular dispersed camping area sits between the stream and the road on the opposite stream bank from the waste rock pile. It is possible that this same area was used for a housing area by the miners as they worked this mine although there are not notable rock formations or building foundations at this site.

Recreationists are drawn to the waste rock pile because of its proximity to the camping area. There is evidence of a lot of foot traffic on the waste rock pile from people exploring the multi colored rocks, soil, and iron pyrite in the pile. This use contributes more pollutants to the river because of the developed erosion patterns on the pile and the tracking of soils from the pile and throwing of rocks from the pile into the river.

The waste rock pile was tested for metal concentrations by the Forest Service and Bureau of Reclamation using an XRF. The pile is consistent with the other mine wastes in the canyon as it contains elevated concentrations of lead, arsenic, zinc, cadmium, and other heavy metals. The pile is easily accessed via the Miller Hill access road. It is noted that this waste rock pile considered separately may not warrant a removal action but with the proposed action at Pacific mine just ¼ mile away it is only reasonable to treat the Scotchman site at the same time.

## 3.0 SITE CHARACTERIZATION

This section describes the site investigation work that has been conducted in AFC and discusses the source, nature, and extent of contamination associated with mine waste materials based on available information and data. Analytical results are presented and compared to appropriate environmental standards. (Much of the information contained in this section was prepared by the Forest Service in preparation for their 2003 Removal Action. Additional information has been added to address the proposed removal actions on private property at Pacific Mine, Pacific Mill, Blue Rock, and Scotchman.)

### 3.1 SAMPLING HISTORY SUMMARY

Under the President's Clean Water Act Action Plan, funding was provided to the Forests for abandoned mine land watershed restoration projects. Through this funding mechanism, thorough studies were conducted on water quality, soils, and biological organisms to assess the full affects of the mine sites on the environment in AFC. A variety of sampling and testing has occurred intermittently in the vicinity of the many mine locations in the North Fork of American Fork Canyon since 1988. The monitoring and testing include water quality samples, metal concentrations in waste rock and tailings, macroinvertebrate populations and diversity in the river, fish tissues sampled for metal concentrations, ground water depths and metal concentrations in ground water at Pacific Mine and Dutchman Flat, and Toxicity Characteristic Leaching Process (TCLP) samples at Pacific Mine and Dutchman Flat. Specific studies and reports comprising the contaminant evaluations in AFC follow:

- Preliminary Survey of Water Quality, Merritt – 1988
- Macroinvertebrate Study in American Fork Canyon, Mangum – 1988
- American Fork Hydrology and Water Quality Study, Lidstone and Anderson – 1992
- Storet Water Data in American Fork Canyon, Utah State – 1992-1996
- Water Chemistry at Pacific and Dutchman Flat, Uinta NF – 1998
- Shallow Well Water Samples at Pacific Mine, Uinta NF – 1999
- Waste Rock Metal Concentration Samples, Uinta NF – 1999
- AFC Tracer Study, USGS – 1999
- Water Quality Monitoring Study in AFC, Uinta NF – 2000
- Macroinvertebrate Verification Study, Mangum and Uinta NF – 2000
- XRF Metal Concentrations at AFC Mine Sites, USBR and Uinta NF - 2000
- AFC Watershed Reclamation Preliminary Investigation Report, USBR - 2000
- Metal Concentrations in Deep Groundwater Wells, Uinta NF – 2001
- Water quality monitoring by the FS at their sites reclaimed in 2003

#### 3.1.1 Surface Water Sampling

The State of Utah has assigned three Beneficial Use Designations to American Fork Creek and its tributaries, from the mouth of the canyon to its headwaters.

The designations are:

- Class 3A - Protected for cold-water species of game fish and other cold-water aquatic life, including the necessary aquatic organisms in their food chain.

- Class 2B – Protected for secondary contact recreation use such as boating, wading, etc.
- Class 4 – Protected for agricultural uses including irrigation of crops and stock watering.

The Class 3A designation carries the more stringent water quality standards. Those standards will be used in this report for determining water quality compliance and exceedances.

Water quality sampling at Pacific Mine and in American Fork River to determine contamination from mining deposits occurred in 1988, 1992, 1998, 1999, 2000, 2000 and 2004. Prior to 1999 the sampling efforts reported total metals while the State of Utah standards for a Class 3A, Cold Water Fishery are based on dissolved metals. In 2000 the Uinta National Forest established monumented water sampling stations throughout the affected waters of the North Fork of American Fork River and performed repetitive sampling at those stations with both total and dissolved metals reported for those samples. Table 3-1 presents some of the results of those samples. The stations reported in Table 3-1 are above, at, and below Pacific Mine to display the impacts to water quality resulting from the mine drainage and water flowing across the tailings pile. The results shown represent the higher metal concentration recorded in 2000.

**Table 3-1. Water Quality Samples Taken by Uinta N.F. at Pacific Mine in 2000 (Dissolved Metals ... Total Metals in ppb).**

| Contaminants | Clean Water Standards* | Stream Above Mine | Mine Discharge | Tailings Discharge | Stream Below Mine |
|---|---|---|---|---|---|
| Lab pH | | 8.1 | 7.7 | 8.2 | 8.3 |
| Arsenic | | <5 . . . <5 | <5 . . . 11.9 | <5 . . . 34.8 | <5 . . . <5 |
| Cadmium | 1.4 | <1 . . . <1 | 8.9 . . . 10.1 | 27.1 . . . 31.3 | <1 . . . <1 |
| Copper | 15.7 | <12 . . . <12 | <12 . . . 24.5 | <12 . . . 41.4 | <12 . . . <12 |
| Iron | | 307 . . . 379 | 112 . . . 2220 | <20 . . . 2840 | 143 . . . 297 |
| Lead | 4.8 | <3 . . . 3.9 | <3 . . . 12.9 | 130 . . . 1720 | 4.1 . . . 42.3 |
| Manganese | | 16.1 . . . 55.9 | 10.2 . . . 7.2 | 36.1 . . . 44.6 | 20 . . . 30.9 |
| Zinc | 140 | 37 . . . 56 | 1300 . . . 1330 | 2520 . . . 2740 | 49.4 . . . 95.4 |

* These values are adjusted for water hardness.

Analysis of the 2000 laboratory tests indicated the presence of elevated levels Concentrations of Concern (COC) in the mine drainage and discharge from the tailings. The impact to the American Fork River waters below these inflows show elevated metal concentrations approaching the maximum concentrations specified by Clean Water Standards for this stream. The affect of this constant influx of metals to the river becomes more apparent when macroinvertebrate and fish samples are examined. Biological uptake of vegetation can result in secondary consumption by wildlife. Other sections of the North Fork of American Fork River have metal concentrations approaching the limits established by the Clean Water Act but no actual exceedances occur in this project area when dissolved metal concentrations are considered.

Post removal action water quality monitoring in and around Pacific Mine shows the extent of the improvements made in the water quality in the river. The removal of the mill tailings at

Pacific was the single most important action improving water quality in AFC achieved thus far. The results of the 2004 water quality monitoring follow in Table 3-2.

**Table 3-2. Water Quality Samples Taken by Uinta N.F. at Pacific Mine in July and Sept. 2004 (Dissolved Metals in ppb).**

| Contaminants | Clean Water Standards* | AFC River Above Mine | Discharge At the Adit | Discharge Into River | AFC River Below Mine |
|---|---|---|---|---|---|
| Lab pH | | 8.25. . 8.2 | 7.1. . 6.9 | 8.7. . 8.6 | 8.5. . 8.5 |
| Arsenic | | < 5 . . . < 5 | < 5 . . . < 5 | < 5 . . . < 5 | < 5 . . . < 5 |
| Cadmium | 1.4 | < 4 . . . < 4 | 21 . . . 11 | < 4 . . . < 4 | < 4 . . . < 4 |
| Copper | 15.7 | < 4 . . . < 4 | 7 . . . 5 | < 4 . . . < 4 | < 4 . . . 7.3 |
| Iron | | < 50 . . . < 50 | 100 . . . < 50 | < 50 . . . < 50 | < 50 . . . < 50 |
| Lead | 4.8 | < 5 . . . < 5 | < 5 . . . < 5 | < 5 . . . < 5 | < 5 . . . < 5 |
| Manganese | | 13 . . . 13 | 23 . . . 22 | 22 . . . 22 | 28 . . . 31 |
| Zinc | 140 | 14 . . . < 100 | 2500 . . . 1400 | 23 . . . 25 | 23 . . . < 100 |

* These values are adjusted for water hardness.

### 3.1.2 Macroinvertebrate Monitoring

Table 3-3 shows the affect of the contaminated water on macroinvertebrate populations. The 1988 samples show that in mid summer the number of organisms above the metal influence from Pacific Mine is about 5 times greater than below the mine, while in late summer the ratio is over 3 times more above the mine. The mass of those populations is 2 to 3 times greater above the mine compared to below the mine.

**Table 3-3. Macroinvertebrate Samples Taken Near Pacific Mine in 1988**

| LOCATION | SAMPLE DATE | ORGANISMS # /m2 | DAT DIVERSITY INDEX | STANDING CROP g/m2 | BIOTIC CONDITION INDEX | NUMBER TAXA |
|---|---|---|---|---|---|---|
| Above Pacific | 07/20/1988 | 13,891 | 11.5 | 1.8 | 91 | 25 |
| Below Pacific | 07/20/1988 | 2,582 | 12.7 | 0.7 | 98 | 25 |
| | | | | | | |
| Above Pacific | 09/21/1988 | 13,091 | 19.2 | 1.4 | 100 | 32 |
| Below Pacific | 09/21/1988 | 3,888 | 15.2 | 0.4 | 100 | 31 |

The 1998 and 2000 samples also show a significant difference in population with the reduced populations downstream from Pacific Mine in the stream stretch most impacted by the metal influx from the mine wastes. No follow-up sampling of macroinvertebrates has occurred since the 2003 removal action was completed.

**Table 3-3a. Macroinvertebrate Samples Taken Near Pacific Mine in 1998 and 2000**

| LOCATION | SAMPLE DATE | ORGANISMS (Abundance) | SHANNON DIVERSITY INDEX | BIOTIC CONDITION INDEX | NUMBER TAXA |
|---|---|---|---|---|---|
| Above Pacific | 08/26/1998 | 61,168 | 2.482 | 83 | 30 |
| Below Pacific | 08/26/1998 | 12,731 | 2.043 | 81 | 30 |
| | | | | | |
| Above Pacific | 07/19/2000 | 14,964 | 2.230 | 83 | 31 |
| Below Pacific | 07/19/2000 | 10,442 | 2.698 | 93 | 30 |
| | | | | | |
| Above Pacific | 09/25/2000 | 96,753 | 2.548 | 75 | 31 |
| Below Pacific | 09/25/2000 | 13,705 | 3.119 | 88 | 46 |

Note: The 1988 samples were analyzed by Dr. Fred Mangum while the 1998 and 2000 samples were processed under the direction of Dr. Mark Vinson.

### 3.1.3 Fish Tissue

The fish tissue samples analyzed in 1999 demonstrate the impacts the Pacific wastes were having on the aquatic habitat downstream. Fish were sampled from five locations in the river, including four fish above Pacific Mine and four fish below the mine. The fish sampled were resident fish (no planters) and ranged in size from 7.4 inches to 10.6 inches. The three native cutthroat and one resident rainbow from below the mine all had lead concentrations in their tissues exceeding that recommended for human consumption. (Biological Report 85... Reviews, 1987 Ronald Eisler, U.S. Fish and Wildlife Service). In comparison the fish below the mine had an average of almost 10 times as much lead as those above the site, with an individual fish exhibiting 20 times more lead below the mine versus individuals above the mine. The average cadmium and zinc concentrations in the fish below the mine were twice that of the fish below the mine while the arsenic level was 1.5 times higher below the mine.

Table 3-4 shows the metal concentrations in the muscle from fish removed from the American Fork River above Pacific Mine (Site 1) and below the mine (Site 2). The samples were obtained on August 5, 1999 and tested at Utah State University's Veterinary Diagnostic Laboratory in Logan, Utah on August 25, 1999. .

**Table 3-4. 1999 Fish Tissue Samples from American Fork River (parts per billion)**

| LOCATION | FISH I.D. | LEAD | ARSENIC | CADMIUM | ZINC |
|---|---|---|---|---|---|
| Above Pacific | 1-1 | 65 | 153 | 129 | 10,120 |
| Above Pacific | 1-2 | 43 | 110 | 103 | 5,100 |
| Above Pacific | 1-3 | 173 | 104 | 65 | 4,674 |
| Above Pacific | 1-4 | 32 | 174 | 39 | 4,378 |
| AVERAGE | ABOVE | -78- | -135- | -84- | -6,068- |
| Below Pacific | 2-1 | 824 | 222 | 77 | 12,639 |
| Below Pacific | 2-2 | 349 | 101 | 55 | 10,778 |
| Below Pacific | 2-3 | 770 | 319 | 113 | 13,396 |
| Below Pacific | 2-4 | 740 | 186 | 420 | 10,445 |
| AVERAGE | BELOW | -670- | -207- | -166- | -11,815- |

Based on these samples, and others taken down canyon, the State of Utah issued a Fish Consumption Advisory in 2001 for the North Fork of American Fork Canyon alerting the general public to the concentration of heavy metals in tissues from resident, native fish found in this stream. The advisory discouraged consumption of these native species primarily because of the arsenic concentrations in the fish. The 1999 samples did not differentiate between the organic and inorganic arsenic in the fish. Papers on this subject suggested that we could anticipate about 10% of the total arsenic would be inorganic in nature, which would correspond to high enough levels that human consumption of the fish was a concern to the State Toxicologist.

The Utah Division of Wildlife Resources, with assistance from the Forest Service, re-sampled the fish in AFC in 2002. The fish tissues were tested during the winter of 2002-2003 with the arsenic especiated to determine the amount of organic and inorganic arsenic. The consumption advisory remained in effect through 2003. The empirical data for the 2002 samples has not been obtained by the author of this document. Information was provided to the Forest Service indicating that the total arsenic was comparable to the 1999 samples but the inorganic arsenic was found to be less that 5% of the total. At that level the fish were considered safe for human consumption. But in 2004 the advisory was removed from the UDWR's web page, the warning signs in the canyon were removed, and no additional brochures were distributed to the public. The Forest Service received notification from the State of Utah in the spring of 2004 that the 2002 fish sample results did not warrant the extension of the fish consumption advisory and it was being rescinded. *(Conversations between Ted Fitzgerald of Trout Unlimited and Ron Smith, Fisheries Biologist with the Uinta National Forest)*

### 3.1.4 Metal Concentrations in Soil, Tailings, and Waste Rock

Pacific Mine site has been the focus of several studies conducted by graduate students seeking advanced degrees from the University of Wyoming and from Utah State University. One Master of Science candidate, Phyllis Ann Bustamante, reported:

> ***"The total Pb content at this site is considerably above the EPA threshold and exists in a form that is harmful to human health... Lead at this site may pose a threat to human health if ingested by children... If this area is to be visited by historians and recreationalists, signs should be posted informing people of the potential hazards of the tailings... Measures should be taken to keep off-road vehicles off of the tailings in order to reduce erosion potential."***

The Forest Service has collected a large number of metal concentrations samples in soil, waste rock, and tailings from most of the mine locations in American Fork Canyon. Table 3-5 provides data showing some of the highest concentration of metals from Pacific Mine (PM), Pacific Mill (Mill), Blue Rock Mine (BR), and Scotchman #2 Mine (SM). (The Pacific Mill sample results reflect the soil samples at the mill site, not the mill tailings previously removed by the Forest Service.)

**Table 3-5. Metal Concentrations in Soil, Waste Rock, and Tailings (ppm)**

| Location | Arsenic | Cadmium | Copper | Iron | Lead | Mercury | Zinc |
|---|---|---|---|---|---|---|---|
| PM T1-2 | 218 | 24 | 321 | 12,100 | 41,800 | 12 | 3,130 |
| PM T2-2 | 696 | 24 | 315 | 21,200 | 27,900 | 36 | 3,540 |
| PM T1-1 | 10 | 157 | 87 | 4,910 | 21,000 | 16 | 19,800 |
| PM T1-9 | 10 | 30 | 1,010 | 25,200 | 35,700 | 15 | 3,890 |
| | | | | | | | |
| Mill XRF54 | - | | 1,630 | 48,896 | 69,069 | 8,486 | 10,899 |
| Mill XRF52 | - | | 2,400 | 61,389 | 35,200 | 4,048 | 10,496 |
| Mill XRF34 | 1,720 | | 1,160 | 22,797 | 28,877 | 1,430 | 8,198 |
| Mill XRF33 | - | | - | 45,389 | 26,394 | 1,090 | 4,778 |
| | | | | | | | |
| BR XRF 67 | - | | - | 32,282 | 28,186 | 2,109 | 2,139 |
| BR XRF 71 | 396 | | - | 13,389 | 3,290 | 289 | 277 |
| BR XRF 4 | 75 | | - | 6,637 | 2,709 | - | 399 |
| BR XRF 69 | 265 | | - | 7,680 | 2,450 | 260 | 707 |
| | | | | | | | |
| SM XRF 1 | 97 | - | - | 24,192 | 1,979 | | 860 |
| SM XRF 2 | - | - | - | 17,498 | 1,040 | | 285 |
| SM XRF 3 | - | - | - | 28,698 | 454 | | 596 |
| | | | | | | | |

Note: The symbol (-) indicates the metal concentration was below detectable limits. No entry indicates there was no test for that metal in that sample.

In a report dated March 21, 2001, prepared for the EPA, Paul Damian PhD, MPH, DABT of Tetra Tech EM Inc. of Denver, Colorado, assessed the contaminant levels found in the various mediums in American Fork Canyon. He recommended a Preliminary Remediation Goal (PRG) for lead to be in the range of 2,161 to 3,760 ppm.

As indicated by the metal concentrations shown in Table 3-5, there is considerable variation in each of the mine deposits. However, except for the Scotchman, each pile tested contained concentrations of lead exceeding the entire range for the PRG. Based on this information it is anticipated that any removal action taken at these sites will address all the mining and mill wastes present at these locations. It is not anticipated that any effort will be made to separate or distinguish between wastes containing less than the PRG from those that exceed that concentration. Furthermore, as will be observed in Table 3-6, it was originally planned by the Forest Service that any excavation of mining wastes would probably include subexcavating into native soils containing metal concentrations exceeding the PRG deposited through leaching of the metals from the overlying wastes as indicated by the TCLP report. However, at each of the sites reclaimed in the 2003 removal action the soils underlying the waste deposits were tested using an XRF. Even the original topsoil layer under the piles had metal concentrations far below the PRG. No subexcavation of underlying soils was needed in the 2003 effort. Therefore, this proposed project does not include plans to subexcavate below the wste rock piles.

### 3.1.5 Leaching Of Metals Based On TCLP Sampling

The data displayed in Table 3-6 was obtained from a USBR report dated November 2000 entitled American Fork Canyon Watershed Reclamation Project. The **bold** values under cadmium and lead exceed Regulatory Levels for TCLP, indicating these metals are subject to

leaching from the mining deposits and migration into subsoils and groundwater. (DH = Drill Hole; TP = Test Pit; CS = Composite Sample)

**Table 3-6. TCLP Metals Method 1311 at Dutchman Flat and Pacific Mine (ppm)**

| Location | Arsenic | Cadmium | Copper | Iron | Lead | Manganese | Zinc |
|---|---|---|---|---|---|---|---|
| DFDH-1-00 | < 2.0 | 3.8 | 0.2 | 0.1 | 25 | 5.1 | 170 |
| DFTP-2-05 | < 2.0 | 0.03 | 0.05 | <0.01 | 260 | 1.1 | 2.7 |
| DFCS-06 | < 2.0 | 1.6 | 0.16 | <0.01 | 79 | 59 | 57 |
| PMCS - 01 | < 2.0 | 0.03 | 0.57 | 0.20 | 220 | 0.62 | 1.9 |
| PMCS - 02 | < 2.0 | 0.07 | 0.66 | < 0.01 | 220 | 0.03 | 5.6 |
| PMCS - 03 | < 2.0 | 0.24 | 0.18 | < 0.01 | 97 | 0.47 | 20 |

TCLP criteria used to determine excessive leachability are Arsenic 5.0; Cadmium 1.0; and Lead 5.0.

### 3.1.6 Metal Concentrations in Groundwater Samples Obtained from Monitoring Wells

The November 2000 USBR report was funded by the Forest Service and included various field investigations at Pacific Mine, Dutchman Flat, and a proposed repository site across the river from Dutchman Flat. Groundwater monitoring wells were installed at each of these locations as part of that study with three wells at Pacific Mine, two wells at the proposed repository site, and one well at Dutchman Flat. In 2001 three more wells were installed at Dutchman Flat during additional soil investigations conducted for the Forest Service by USBR's Provo Area Office. All the wells were monitored for water depths on a monthly basis from May though October, 2001.

**Table 3-7. Groundwater Monitoring Wells Metal Concentrations (ppb)**

| LOCATIONS | Al | As | Cu | Fe | Pb | Mn | St | Zn | Well Depth (ft) | Depth to Water |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | **Dissolved** | **Metals** | | | | | |
| Repository West | 520 | <5.0 | 12 | 690 | 34 | 40 | 41 | 3,100 | 20.9 | 3.1 |
| Repository East | <100 | <5.0 | 14 | 130 | 12 | 16 | 32 | 160 | 20.5 | 6.7 |
| Pacific SE | <100 | 300 | <4.0 | 16,000 | 10 | 270 | 45 | 7,400 | 20.6 | 2.4 |
| Pacific NE | <100 | 35 | <4.0 | 1,300 | 3 | 120 | 51 | 1,500 | 19.8 | 1.2 |
| Pacific North | | | | | | | | | 18.0 | Dry |
| Dutchman Flat | | | | | | | | | 20.5 | Dry |
| | | | | **Total** | **Metals** | | | | | |
| Repository West | 2,500 | 7.7 | 16 | 2,700 | 80 | 42 | 32 | 2,300 | 20.9 | 3.1 |
| Repository East | 700 | <5.0 | 20 | 1,100 | 43 | 40 | 34 | 170 | 20.5 | 6.7 |
| Pacific SE | 120 | 230 | <4.0 | 13,000 | 18 | 280 | 42 | 6,700 | 20.6 | 2.4 |
| Pacific NE | 140 | 37 | 7 | 1,700 | 95 | 140 | 53 | 1,700 | 19.8 | 1.2 |

Note: These water samples were also tested for cadmium and mercury. No samples tested above the minimum detection level of 4 ppb and 0.2 ppb respectively.

The Dutchman Flat wells were constantly dry indicating the ground water table at this location is more than 20 feet below the surface. The monitoring well at Pacific Mine located approximately 100 feet from the plugged adit was also dry all summer. The other wells collected water for part or all of the period they were monitored. In May, 2001 water samples were obtained from the wells that had water in them. This water was tested by American West Analytical Laboratories of Salt Lake City to determine metal concentrations. The results of those water samples are displayed in Table 3-7.

It is interesting to note that the wells installed at the originally proposed repository site across the river from Dutchman Flat are approximately 1/4 mile from the nearest abandoned mine (Bay State) and yet the groundwater at this location has metal contents often comparable or exceeding the metal contents for the wells at Pacific Mine. The two wet wells at Pacific Mine are located in the tailings pond where the ground water table extends up into the tailings to within a foot of the surface. This is insufficient data to draw any conclusions about the general quality of the ground water in American Fork Canyon or Mineral Basin. There are no other known wells in the vicinity. It does, however, raise the question of what changes in metal concentrations in the groundwater might be predicted at Pacific Mine after the tailings were removed. These wells will all remain in service after any removal actions are completed in American Fork Canyon and will be monitored to determine if there is a change in the ground water levels or water quality post removal. The Forest Service did not include water quality sampling from these ground water wells during their 2004 monitoring exercises even though their Operations, Maintenance, and Monitoring Plan included sampling and testing from the wells.

## 3.2 CONTAMINANT MIGRATION PATHWAYS

### 3.2.1 Ground Water Pathway

It is highly likely that the groundwater underlying each of the mine, mill, and smelter sites intersects with the surface water in the North Fork of American Fork River. However, the groundwater under each site is not necessarily coming in contact with the wastes/tailings. There are several shallow (5-6 feet) monitoring water wells and 3 deep (20 feet) wells at Pacific Mine. The wells located in the tailings deposit showed the ground water level extends above the native soils into the tailings, often within 1 foot of the surface. However, the deep well located above the waste rock piles about 100 feet from the adit has remained dry since it was installed in 2000. In wet years, the water table surfaced at the lower end of the tailings, which produced a spring carrying very high concentrations of metals. The spring usually dried up within a month after snowmelt but during that period it flowed from its origin, across the tailings for 80 feet entering American Fork River. The spring location was active during the excavation of the tailings as the excavation approached the lower levels. As the area was backfilled and recontoured the ground water no longer raised to the surface. This area is now covered with sedimentation ponds fed by mine drainage exiting the beaver pond at Pacific. Water quality samples from the lower pond show reduced levels of lead and zinc in the water discharging from the ponds into the river. See Table 3-2.

Ground water discharges from the Pacific Mine adit and flowed over the waste rock and tailings deposits as surface water before entering the river prior to the 2003 removal action. At Pacific Mine it can be stated that the groundwater is very close to or at the surface throughout most of the tailings pond area. The upper waste rock pile located on private property does not

have water showing in the monitoring well there at a depth of 20 feet. The mine drainage now runs through a rock lined ditch from the pipes below the adit to the historic beaver pond. As the beaver pond overflows most of the water runs through the series of sedimentation ponds in the reclaimed tailings pond area. The water quality discharging from those ponds into the river meets the standards for a cold water fishery.

The Dutchman Flat repository sits on a natural bench some 100 feet above and 350 feet away from the riparian zone of American Fork River. There are four water monitoring wells at this site, all of which have continually been dry. The water table is at least 20 feet below the mine wastes contained in the repository.

Two additional groundwater monitoring wells are located at a previously proposed repository site across the river from Dutchman Flat. These wells indicate the water table there varies in elevation from just a few feet below the surface during spring months to nearly 20 feet below the surface in late fall. Bay State Mine is located on the same hillside about 600 feet away from these three wells. The mine is approximately 50 feet higher in elevation where the steep mountainside flattens into the bench above the river. The mine adit has a "bat gate" restricting entrance to humans and large mammals. The mine does not produce any discharge and there are no defined waterways in the area of the mine and reclaimed waste rock pile. The water table is probably not far below the waste pile but it is doubtful that the water table ever extended into the waste pile.

There is a spring on the hillside near the Blue Rock waste rock pile. That water remains on the surface for a short distance before it again returns to subterraneous flow. Some of that water does enter a ½ inch poly-ethylene pipe and is discharged at the cabin site/loading chute adjacent to the waste rock pile. That water immediately goes back into the ground.

So here you have what is known about the ground water in the area of the mine sites in and around the Pacific site. There are no other known wells in the area but there are spring sources throughout this glaciated canyon. The tracer studies that were done by USGS on the North Fork of American Fork River and on Mary Ellen Gulch identify the water sources that enter these waterways. They are numerous and generally show good water quality unless they are in contact with one of the abandoned mine, mill, or smelter sites in the canyon.

### 3.2.2 Surface Water Pathway

The sites of interest for this EE/CA are the Pacific Mine, Pacific Mill, Blue Rock, and Scotchman sites. The North Fork of American Fork River flows some 300 feet or more away from the first three sites listed above but the river actually contacts the toe of the waste rock pile at Scotchman for about 70 feet. The composition of the waste rock along the river bank is generally course material. High flows have removed most of the fines in this lower reach. None the less, this site is a source of sediment and contamination to the river due to the continuing erosion of the upper portions of the pile. That erosion results from heavy precipitation events but it is increased because of the disturbance of the pile by recreationists. The soil tests for heavy metals at this site consisted of three XRF readings taken in the upper portion of the pile. Although those readings were relatively low in metal concentrations, it is proposed that this pile be removed as part of the Pacific mine removal action thus removing a potential source of sediment and heavy metal contamination.

Water from an adit adjacent to the Pacific Mine flows across the mine site and into the river. Fish tissue samples have been collected from five reaches of the North Fork of American Fork River from its confluence with the South Fork to the highest known location of fish in the stream above Pacific Mine. Contaminated fish were found from below Pacific Mine to below Tibble Fork Reservoir near the confluence. These samples were high in arsenic, cadmium, zinc, and lead with arsenic raising the highest concern with State and Local health officials. Fishing is a popular recreation activity in the canyon. Any resident fish that is caught and consumed may have elevated levels of heavy metals. The State of Utah issued a fish advisory in 2002 recommending no consumption by women and children of resident fish (browns and cutthroat) taken from this stream and recommended consumption of those fish by men to not exceed one fish per month.

The removal action completed by the Forest Service in 2003 has significantly improved the water quality in the river below Pacific mine and further down canyon. Over time the concentrations of metals in fish tissues in the canyon should be lower than those found there before the removal action. However some metals like arsenic will be retained by those contaminated fish throughout their lives. But future hatches of fish will not be exposed to the same concentrations of heavy metals formerly present in the river. But the possibility exists for water from the adit at Pacific to be diverted from its present channel to a location that would run along the waste rock pile at Pacific. Any contaminated waters from that site would have to pass through the sediment ponds constructed in the reclaimed Pacific tailing pond before they would enter the river. So it is still possible for elevated levels of heavy metals to occur in the river below Pacific mine due to the waste deposits still exposed there. The proposed removal action will practically eliminate the potential for heavy metal contamination from occurring due to a release from the waste deposits at Pacific mine.

At the Blue Rock mine an intermittent stream that carries snow melt and runoff from precipitation runs along the toe of the waste rock pile. Any water transported in this side drainage flows approximately 700 feet from the waste pile before it enters the river. This site is not considered a significant source of contamination to the river because it seldom flows any water. Still sediment and heavy metal contamination from this site add to the loading in the river.

Water is not taken from the river for municipal or public consumption. It is possible that recreationists could obtain water from the river for drinking. The river water is collected near the city of American Fork for irrigation purposes. The concentrations of heavy metals in the water at this point are sufficiently diluted so they do not constitute a violation of approved standards.

### 3.2.3 Soil Exposure and Air Pathway

Prior to the 2003 removal action, all of the tailings, waste rock, and smelter wastes associated with the former mining operations were uncovered and uncontained. There are institutional controls in place at the Pacific Mine, in the form of steel guardrail barriers, fences, and large warning signs. The barriers significantly restrict vehicle access to the waste rock pile however vehicle access is not impossible. Hikers can easily access the site. The Miller Hill access road crosses over the top of the waste rock pile for a distance of about 200 feet.

On windy days, the fines at Pacific mine and mill are visibly blow around the area. This occurs to a small degree at the other sites. The tailings at Pacific Mine are high in lead which is known to retard the mental development of children. Children have been observed on ATVs driving on these tailings prior to the installation of the barriers and fences. Small children have "played in the sand pile" at the Pacific tailings making sandcastles from the tailings saturated by the mine drainage. But since the installation of the signs and barriers, public use of these areas for recreation has dropped a great deal, perhaps as much as 95% of what it formerly was. Never the less, people and wildlife are still coming in contact with the pollutants exhibited at each of these sites.

### 3.2.4 Drinking Water Targets

The nearest drinking water use is located approximately 4 miles down canyon from the Site at Tibble Fork Reservoir. There are numerous campgrounds and picnic areas below Tibble Fork Reservoir to the mouth of the canyon with water systems in place. Timpanogos Cave National Monument's visitor's center is eight miles from the Site straddling American Fork River. The water systems for all of these facilities are constantly monitored for contamination and have not been found to be in violation of drinking water standards. Campers along the North Fork of American Fork River may obtain water from springs and surface waters for various uses including consumption but this would be a rare occurrence in this area.

### 3.2.5 Human Food Chain Targets

Fish and big game are harvested by recreationists throughout the American Fork drainage. There may be elevated heavy metals in the flesh of these fish and animals from exposure to contaminated waters or from eating plants that have taken up some of the metals. Public officials have become concerned about the consumption of fish taken from the North Fork of American Fork River. A fish advisory was issued in 2002 as stated previously. There is no evidence of other game animals having been contaminated by exposure to the mine sites and surrounding vegetation. No concerns have been expressed concerning effects to game animals from these mine wastes by any persons or authorities.

The site is within the boundaries of the permitted Snake Creek Sheep Allotment. Presently the Management Plan does not provide grazing in the canyon bottoms and the sheep have not been near the mine locations for several years and are not expected to utilize this area in the future. Forest personnel will work with the permitees to ensure the sheep do not occupy the area during the period following reclamation and vegetation reestablishment.

### 3.2.6 Environmental Targets

The Site contains both riparian and upland areas. The terrestrial area is utilized for migration and breeding of large animals (elk, deer, moose). Many small mammals and birds utilize these areas. Bats have been observed in some of the mines and bat gates were installed in some adits to allow their continued use of those roosting sites. The river is home to the Bonneville Cutthroat trout (Oncorhyncus clarki utah), a sensitive species. Although Pacific Mine has been barricaded, fenced, and signed to discourage public use of the sites, large numbers of people still congregate nearby. Therefore, human health remains a concern. It is noted that on two separate occasions, six packs of beer were found cooling in the water at the Pacific adit.

### 3.2.7 Soil Exposure and Air Pathways

Human recreational activity occurs in the area, some soil contact or air born particles probably occur. The tailings material at the mill site is fine in texture from the refining processes and becomes air born when dry. When construction activities occur at the site, considering the high levels of metals in some of the deposits, workers will be required to have taken the appropriate HAZWOPPER training and safety measures will be observed to prevent unwarranted exposure.

Vegetation in the area is commonly forest type. The main tree species on the site are Douglas Fir and Quaking Aspen. There are no threatened or endangered or sensitive plant species in the area that can be affected by metal uptake in the soils or air born particles. Access for recreationists to the sites will be limited during the removal/excavation process to minimize soil/airborne exposure to human targets. EPA has indicated that air quality monitoring by the proponent of this action will be expected during the removal action.

### 3.2.8 Resident Population Targets

The resident population at the Site is zero. There are eight to ten human dwellings 6 miles downstream of the Site. The closest municipalities are American Fork and Alpine some 11 miles from the site at the mouth of American Fork Canyon. The closest people living near the project site are at Snowbird Ski Resort. Some of them work within 2 miles of the project but do not come in contact with the sites of interest in this document.

### 3.2.9 Sensitive Environment Targets

The North Fork of American Fork River is home of the Bonneville Cutthroat trout (Oncorhyncus clarki utah), a sensitive species. This river is included in the waters where recovery efforts for this species are to occur in accordance with the Conservation Strategy developed by the U.S. Fish and Wildlife Service, the Forest Service, and others. There are no federally listed sensitive areas in or adjacent to the Site.

## 4.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Section 300.415(j) of the NCP requires that removal actions under CERCLA section 104 attain applicable or relevant and appropriate requirements (ARARs). At certain sites, ARARs may form the basis of the removal action objectives. They help in determining how "clean is clean" at a site and are a guide in remedy implementation.

ARARs are either applicable or relevant and appropriate. Applicable requirements are those cleanup standards, standards of control, or other substantive environmental protection requirements, criteria or limitations promulgated under Federal or State environmental laws that specifically address a hazardous substance, pollutant, contaminant, cleanup action, location, or other circumstances found at a CERCLA site. Applicable requirements are those that a party or agency would have to comply with by law if the same action were being undertaken apart from CERCLA authorities. Relevant and appropriate requirements are those cleanup standards that address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the particular site. They make sense given the circumstances at the site. Once a requirement has been determined to be relevant and appropriate, it has to be complied with to the same extent as if it were applicable.

State requirements may also be ARARs. In order for a state requirement to be an ARAR it must be promulgated, meaning of general applicability and legally enforceable. It must be more stringent than Federal requirements. Finally, it must be identified by the State in a timely manner.

There are three different types of ARARs: (1) chemical-specific, (2) location-specific, and (3) action-specific. Chemical specific ARARs are typically health- or risk-based numerical values that represent cleanup standards. Location-specific ARARs are restrictions on the concentration of hazardous substances or the conduct of activities in environmentally sensitive areas. Action-specific ARARs are usually technology- or activity-based requirements or limitations on cleanup actions.

Sometimes there are no ARARs to serve as cleanup levels for a particular site or contaminant. In these situations, it is appropriate to consider non-promulgated criteria, advisories, guidance, and proposed standards issued by Federal or State governments. This category of cleanup goals is called "to be considered" or TBCs. TBCs may be relied on in making cleanup decisions, but they are not potential ARARs because they are neither promulgated nor enforceable.

Actions taken on-site during a CERCLA cleanup must comply only with the substantive portions of a given ARAR. On-site activities need not comply with administrative requirements such as obtaining a permit, record keeping, and reporting. On-site means the areal extent of the contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action. Actions taken off-site must comply with both the substantive and administrative requirements of applicable laws and regulations.

Removal actions, as opposed to remedial actions, need only comply with ARARs to the extent practicable given the exigencies of the situation and the scope of the removal action. During most non-time critical removal actions, such as the one being contemplated for the American Fork Canyon, there is sufficient time to identify and evaluate ARARs. Only ARARs that address activities within the scope of the removal action need to be considered. For example, ARARs pertaining to treatment of a contaminated ground water aquifer are outside the scope of a cleanup involving capping a waste pile.

### 4.1 ARARs for the American Fork Canyon Site

Appendix A contains a table entitled *Contaminant-Specific Applicable or Relevant and Appropriate Requirements, American Fork Canyon Site* identifies ARARs that were evaluated for the American Fork Canyon Site. The table includes state ARARs that were submitted for consideration on July 5, 2000, by the State of Utah. Key ARARs are discussed below.

One alternative under consideration is off-site disposal of the mine waste. Any material taken off-site will have to be disposed in a facility that is permitted to accept the mine waste material. That facility must be in current compliance with their operating permit.

Certain alternatives contemplate on-site consolidation and capping. For these alternatives, certain provisions of the State of Utah hazardous and solid waste regulations are relevant and appropriate. For example, the cap would be designed to exceed the cover requirements for closing solid waste landfills. Run-off measures will be designed to meet or exceed the State landfill requirement to control the 25-year storm event.

All alternatives, other than the no action alternative, will be subject to requirements to control storm water. Fugitive dust control will be a component of each alternative except for the no action alternative. Requirements to treat discharges to surface or ground water are outside the scope of this removal action, and therefore, are not ARARs.

## 5.0 STREAMLINED RISK EVALUATION

Streamlined baseline human health and ecological health risk assessments were conducted for the mill site, waste rock, surface water, and fish tissue at the Site. The evaluation is presented to address potential risks associated with mine waste dumps and contaminated soils at the mill site. A comparison is made between the analytical data and the risk standards.

A removal action will be considered on all four separate treatment areas with an anticipated common solution for all four sites and thus the risk analysis discusses all the sites at the same time. Sampling for heavy metal concentrations were taken at each of the sites over a period of several years starting in the mid 1990's. The values used in the tables for the four sites represent the worst case values found at each sites. The human health and ecological risk assessments will involve three steps: hazard identification, toxicity assessment, and risk characterization. An exposure assessment and risk calculation have been completed by the BLM and are reflected in the risk management criteria tables (Tables 5.1 through 5.4) prepared by the BLM and used in this EE/CA. (Risk Management Criteria For Metals at BLM Sites, Technical Note 390 revised December 1996; U.S. Department of the Interior – Bureau of Land Management; Karl L. Ford, PhD, National Applied Resource Sciences Center, Denver, CO; used with updated information dated October 5, 1998 as issued by the BLM). EPA ambient water quality criteria values (Table 5.5) are also used in this EE/CA for the purposes of providing additional information on water quality.

### 5.1 TABLES CONTAINING STANDARDS FOR RISK EVALUATION

**Table 5.1. BLM Human Risk Criteria for Soils**

| Contaminant, mg/kg | Camper | ATV Driver | Surveyor |
|---|---|---|---|
| Arsenic | 20 | 300 | 100 |
| Cadmium | 70 | 950 | 800 |
| Copper | 5,000 | 70,000 | 59,000 |
| Lead | 1,000 | 1,000 | 2,000 |
| Zinc | 40,000 | 550,000 | 480,000 |

**Table 5.2. BLM Human Risk Criteria for Surface Water**

| Contaminant, ug/l | Camper | ATV Driver | Surveyor |
|---|---|---|---|
| Arsenic | 93 | N/A | N/A |
| Cadmium | 155 | N/A | N/A |
| Copper | 11,490 | N/A | N/A |
| Lead | 50 | N/A | N/A |
| Zinc | 92,909 | N/A | N/A |

**Table 5.3. BLM Human Risk Criteria for Fish**

| Contaminant, ug/kg | Camper | ATV Driver | Surveyor |
|---|---|---|---|
| Arsenic | 48 | N/A | N/A |
| Cadmium | 161 | N/A | N/A |
| Copper | 5,984 | N/A | N/A |
| Lead | 200 | N/A | N/A |
| Zinc | 48,390 | N/A | N/A |

**Table 5.4. BLM Wildlife Risk Management Criteria for Soils**

| Contaminant, mg/kg | Deer Mouse | Mule Deer | Rocky Mountain Elk | Mallard | Canada Goose | Robin |
|---|---|---|---|---|---|---|
| Arsenic | 230 | 200 | 328 | 116 | 61 | 4 |
| Cadmium | 7 | 3 | 3 | 1 | 2 | 0.3 |
| Copper | 640 | 102 | 131 | 141 | 161 | 7 |
| Lead | 142 | 106 | 127 | 59 | 34 | 6 |
| Zinc | 419 | 222 | 275 | 196 | 271 | 43 |

**Table 5.5. Selected EPA Ambient Water Quality Criteria**

| Contaminant mg/kg | Freshwater Aquatic Life Acute Exposure | Freshwater Aquatic Life Chronic Exposure | Human Ingestion of Water + Fish |
|---|---|---|---|
| Arsenic | 850 | 48 | 0.002 |
| Cadmium | 3.9 (a) | 1.1 (a) | 10 |
| Copper | 18 (a) | 12 (a) | N/A |
| Lead | 82 (a) | 3.2 (a) | 50 |
| Zinc | 120 (a) | 110 (a) | N/A |

(a) Computed from hardness; (100 mg/l used). Source: EPA, 1986.

## 5.2 HAZARD IDENTIFICATION

Hazard identification is conducted to identify the contaminants of concern (COC) at the sites. Each COC must meet three criteria established by the EPA (EPA 1989): (1) the constituent is present at the site; (2) the measured constituent concentrations are significantly above background concentrations (defined as three times the average concentration in the background samples); and (3) the constituent analytical results must meet the quality assurance and quality control (QA/QC) criteria set for the data.

The COCs that are present in the soils at the mill site, waste rock piles, surface water, and fish tissue that meet the QA/QC requirements and exceed the documented background concentrations are arsenic (As), cadmium (Cd), copper (Cu), lead (Pb) and zinc(Zn). It is noted that the three samples taken at the Scotchman did not demonstrate significantly high levels of any of the COC's.

## 5.3 TOXICITY ASSESSMENT

The toxicity assessment evaluates the potential for COC to cause adverse effects in exposed populations. Toxicity assessments are presented below for As, Cd, Cu, Pb, and Zn. (ATSDR Public Health Statement, June 1990. Lead, arsenic, copper, zinc, cadmium.)

Arsenic

Arsenic is very widely distributed in the environment and all humans and animals are exposed to low levels of this element. Most humans will ingest their arsenic (about 25-50 micrograms per day) with lower amounts coming from air and drinking water.

Arsenic enters the body primarily through ingestion (via water or food) where it enters the bloodstream. It can also be inhaled into the lungs and thus absorbed into the bloodstream. Most arsenic is converted by the liver to a less toxic form and excreted in the urine except at high exposure levels. Large doses can produce death. Lower levels produce stomach distress with other effects being decreased production of red and white blood cells, abnormal heart function, blood vessel damage, liver and/or kidney damage, and impaired nerve function. There is a link to an increase in lung cancer if the arsenic is primarily inhaled.

Inorganic forms of arsenic are used to kill plants, insects, or rodents and so acute effects can be present at a site. Arsenic ingested at chronic levels by wildlife at the Site will thus introduce some of that arsenic into the food chain. Macroinvertebrates high in arsenic will pass that along to the fish that consume them just as arsenic laden plants will become arsenic laden food for elk, deer and moose.

Cadmium

Cadmium is a naturally occurring element in the earth's crust with small quantities occurring naturally in air, water, soil, and food. For most people, food is the primary source of cadmium exposure. Food material tends to take up and retain cadmium such as plants taking it up from the soil, fish from the water, etc.

Cadmium enters the body primarily through ingestion (via food or water). It can cause severe irritation to the stomach, vomiting and diarrhea. Inhalation can lead to irritation of the lungs. It has been determined that cadmium is a carcinogen. Lung cancer has been shown to occur in animals exposed for long periods of time to cadmium in the air. Other problems include kidney damage, lung damage such as emphysema, high blood pressure, liver damage, immune system damage, and nervous system damage. Reproductive and developmental effects have been observed in animals with high cadmium in their systems but these effects have not appeared in humans.

Copper

Copper is a naturally occurring reddish metal. Copper occurs in rock, soil, water and air but can also occur naturally in plants and animals. It is an essential element for all known living organisms; human, plant and wildlife.

Copper can enter the body through drinking water, consumption of food containing copper and inhalation. Long term exposure to copper dust can irritate your nose, mouth, and eyes and cause headaches, dizziness, nausea, and diarrhea. High doses can cause liver and kidney damage and even death. Very young children are sensitive to copper which can cause damage to their liver or death. Copper is not known to cause cancer. It is known to be very toxic to aquatic life in small amounts. High levels of copper in water have been shown to damage animal livers and kidneys.

Lead

Lead is a naturally occurring bluish-gray metal found in the earth's crust. Lead can be found almost anywhere; in plants and animals, water, soil, rock, air.

Lead enters the body primarily through ingestion and inhalation vs. dermal contact. Most of it is then stored in the bones. For young children, lead has been shown to decrease their IQ scores (reduced intelligence), slow their growth and cause hearing problems. Problems with learning can continue as the children get older. Very high exposure to lead can cause brain and kidney damage in both adults and children. High levels of lead can result in sperm damage and male reproduction problems. Exposure to lead by pregnant mothers can cause damage to the fetus, premature birth, low birth weight, or even miscarriage. Rats and mice given large doses of lead have developed tumors although cancer in humans has not been shown.

Zinc

Zinc is a naturally occurring metal found in the air, soil and water and all foods. It is an essential food element needed by the body in low doses.

Zinc enters the body through the digestive tract when a person eats food or drinks water with zinc in it. It can also enter via the lungs in the form of dust particles. Normally, zinc leaves the body via urine and feces. High doses of zinc will cause stomach and digestion problems and interfere with the body's immune system. It will interfere with the body's ability to take in and use other essential minerals such as copper and iron. Large amounts of inhaled zinc can cause metal fume fever. Long term effects of zinc exposure are unknown and a tie to cancer is unproven.

### 5.3.1 Risk Characterization

As, Cd, Cu, Pb, and Zn all cause some detrimental heath effects on humans with cadmium and arsenic being carcinogens. According to the BLM Risk Tables, cadmium causes the most harm to non-aquatic wildlife in the lowest doses followed by lead and arsenic. According to EPA ambient water quality criteria, cadmium, copper and lead pose the greatest risk to aquatic wildlife.

The concentrations of metals in the tailings, smelter wastes, waste rock, surface water, and fish tissue were compared to the BLM risk management criteria to evaluate the potential risk posed by these toxic metals. Criteria have been developed for both human health and ecological areas. Because of various toxicological and site-specific uncertainties, the following guidelines (Ford, 1996) are recommended in applying the BLM criteria:

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- Less than or equal to the criteria: Low risk
- >1 to 10 times the criteria: Moderate risk
- >10 to 100 times the criteria: High risk
- [redacted]

The results are compared to the BLM criteria in Tables 5.6 through 5.16. The shading shown above is used in the comparative tables to depict the level of risk associated with each sample's result.

## 5.4 HUMAN HEALTH

The metal concentrations shown in the following tables represent a monitoring sample taken at Pacific Mine, others taken at Pacific Mill, Blue Rock and Scotchman. Each of these four samples were selected for consideration in the streamlined risk evaluation because they represent some of the higher test results at these sites and therefore present the greatest risk to the receptor. The greater the risk associated with the individual toxic metals, the more likely an adverse health affect may occur with the receptor. Those affects vary by metal, exposure, sensitivity of the receptor, and a host of other factors. Accordingly, no attempt is made here to predict what may happen to a receptor based on their exposure to these contaminants other than to recognize that an adverse health affect could occur.

### 5.4.1 Human Health Exposure To Soils

The first area of concern is the evaluation of human health risk at the Site. Tables 5.6 through 5.10 show the exposure scenarios related to campers, ATV Drivers, and Surveyors to soils, water, and fish.

**Table 5.6. Human Risk Table for Exposure by a Camper to Soils**

| Contaminant mg/kg | | BLM Criteria | Pacific Mine | Pacific Mill | Blue Rock | Scotchman |
|---|---|---|---|---|---|---|
| Arsenic | | 20 | 402 | [redacted] | 1,709 | 97 |
| Cadmium | | 70 | <41 | No Test | No Test | <45 |
| Copper | | 5,000 | 275 | 2,400 | 741 | <102 |
| Lead | | 1,000 | 16,998 | [redacted] | 46,592 | 1,979 |
| Zinc | | 40,000 | 2,509 | 20,890 | 7,066 | 860 |

Shaded areas indicate that the test value at the individual sites exceeds the BLM risk criteria for exposure for campers. Arsenic and lead present a Extremely High Risk to campers at Pacific Mill, a High Risk at Pacific Mine and Blue Rock, and a Moderate Risk at Scotchman. Fortunately the Mill Site is too steep to set up a camp on.
*(The reason there were no tests for Cadmium at Pacific Mill and Blue Rock is that the XRF normally used by the USBR in Provo was in for repair and a borrowed XRF was being used at those sites. The borrowed XRF was a single source machine and did not have the capability to test for Cadmium.)*

**Table 5.7. Human Risk Table for Exposure by an ATV Driver to Soils**

| Contaminant mg/kg | | BLM Criteria | Pacific Mine | Pacific Mill | Blue Rock | Scotchman |
|---|---|---|---|---|---|---|
| Arsenic | | 300 | 402 | 3,667 | 1,709 | 97 |
| Cadmium | | 950 | <41 | No Test | No Test | <45 |
| Copper | | 70,000 | 275 | 2,400 | 741 | <102 |
| Lead | | 1,000 | 16,998 | | 46,592 | 1,979 |
| Zinc | | 550,000 | 2,509 | 20,890 | 7,066 | 860 |

Shaded areas indicate that the test value at the individual site exceeds the BLM risk criteria for exposure for ATV drivers. Lead presents the ATV rider with a High Risk at Pacific Mine while arsenic is a Moderate Risk. Pacific Mill, Blue Rock, and Scotchman are all so steep that there is no evidence that ATV use has occurred at those sites.

**Table 5.8. Human Risk Table for Exposure by a Surveyor to Soils**

| Contaminant mg/kg | | BLM Criteria | Pacific Mine | Pacific Mill | Blue Rock | Scotchman |
|---|---|---|---|---|---|---|
| Arsenic | | 100 | 402 | 3,667 | 1,709 | 97 |
| Cadmium | | 800 | <41 | No Test | No Test | <45 |
| Copper | | 59,000 | 275 | 2,400 | 741 | <102 |
| Lead | | 2,000 | 16,998 | 99,994 | 46,592 | 1,979 |
| Zinc | | 480,000 | 2,509 | 20,890 | 7,066 | 860 |

Shaded areas indicate that the test value at the individual site exceeds the BLM risk criteria for exposure for a surveyor. Lead and arsenic presents a Moderate Risk to surveyors at Pacific Mine and a High Risk at Pacific Mill and Blue Rock indicating care needs to be taken as these sites are excavated and removed to prevent inhalation or ingestion of dust or soil.

The above information indicates that the metals of concern for human health are arsenic and lead. The problems associated with arsenic and lead are associated with not only campers but with ATV drivers and surveyors. Surveying is an activity group whose exposure may be closely associated with the exposure by hikers. The waste rock pile at Pacific Mine has been signed and barricaded to prevent vehicle use on the pile but recreationists still explore all four of the locations. Restricting this use of the sites is difficult to enforce because of the remoteness of the sites and the publics desire to experience the mining heritage of the canyon. Institutional controls (signs, fences and barriers) to prevent potential exposure to humans can be expected to be marginally successful. Many people discount warnings of the potential threat associated with the mine wastes and enter these interesting sites at will.

The critical issue at Pacific Mine is the exposure by children riding ATVs on the tailings and wastes. This activity makes the soil particles airborne which are then easily inhaled and

ingested. Lead in the air can be carried long distances from where it was released thus affecting all individuals in the vicinity of the ATV user(s) on the tailings and wastes. For the most part, the signs and barriers have discouraged most of the ATV use on the waste rock pile. But the Miller Hill access road still crosses the top of the pile so the risk has not been eliminated even for ATV users.

### 5.4.2 Human Health Exposure To Surface Water

Humans would be exposed to water containing elevated heavy metal contents if they were to drink or otherwise consume the water in the North Fork of American Fork Canyon. The surface waters near the Pacific site are those waters identified as having the highest metal contents in the project area. Table 5.9 showed the risks associated with consuming those waters as existed before the 2003 Removal Action. The concerns with the water at the adit still remain but the high metal concentrations due to the Pacific Tailings and in the river below the mine have been remediated. As noted previously, there is still a concern that the adit drainage could be diverted back to the waste rock pile and the metal concentrations in that flow increased due to leaching of metals from those wastes.

**Table 5.9. Human Risk Table for Exposure by a Camper to Surface Water**

| Contaminant ppb | BLM Criteria | Pacific Mine Adit | Pacific Tailings | NFAF Below Pacific Mine |
|---|---|---|---|---|
| Arsenic | 93 | 11.9 | 34.8 | <5 |
| Cadmium | 155 | 10.1 | 31.3 | <1 |
| Copper | 11,490 | 24.5 | 41.4 | <12 |
| Lead | 50 | 12.9 | 1740 | 42.3 |

Shaded areas indicate that the test value at the individual site exceeds the BLM risk criteria for a camper. The surface waters in American Fork Canyon present a Low Risk to campers. Prior to the 2003 Removal Action, the water flowing across the tailings deposit at Pacific Mine did present a High Risk to anyone who ingested that water.

There are no BLM risk criteria for ATV drivers and surveyors for surface water. The other sites do not have surface water running through them although the American Fork River runs close by some of the sites. Lead in surface water was a high risk to campers at the Pacific Mine tailings but the water in the newly constructed ponds at the reclaimed tailings pond are not a risk to humans from heavy metal concentrations. There is evidence of campers and picnickers all around the Pacific Mine and on the waste rock pile near the adit even on the private property.

### 5.4.3 Human Health Exposure To Fish Tissue (Muscle)

Humans would be exposed to fish tissue contamination if they ate the fish they caught on or near the Site. Both muscle and liver tissue were tested and the results below are for the muscle.

**Table 5.10. Human Risk Table for Exposure by a Camper from Eating Fish**

| Contaminant mg/kg | BLM Criteria | Above Pacific | Below Pacific | Dutchman & Major Evans | Above Tibble Fork Reservoir | Below Tibble Fork Reservoir |
|---|---|---|---|---|---|---|
| Arsenic | 48 | 135 | 207 | 137 | 487 | 395 |
| Cadmium | 161 | 84 | 166 | 55 | 27 | 29 |
| Lead | 200 | 78 | 670 | 140 | 194 | 179 |
| Zinc | 48,390 | 6,068 | 11,815 | 5,534 | 5,326 | 6,345 |

Potential human health hazards from eating fish contaminated with high heavy metal concentrations in their tissue requires consumption of multiple fish. The danger is not tied to eating just one fish. Therefore the values presented in the table represent the average metal concentrations from a total of four fish taken at each of the locations shown. Arsenic in fish tissues presents a Moderate to High Risk to anglers for all resident fish consumed from American Fork River. Those fish found just downstream from Pacific Mine also present a Moderate Risk from cadmium and lead.

Tibble Fork Reservoir is where most of the fishing is concentrated along this water course. Still some fish are taken from the river and consumed by Campers and Day-Use Visitors. The stream above and below Tibble Fork has the worst problem of all the areas tested for arsenic in fish. The reservoir is supplied by water coming from more mines than just the four individual sites discussed in this EE/CA however, significant reductions in the metals going into the American Fork River via these sites would reduce the metals loading to the reservoir. From this it can be inferred that the fish would be consuming less contaminated food sources and would be living in cleaner water, thus leading to lower metal levels in their bodies. Fish reared in the river will always have elevated levels of some metals because the watershed is heavily mineralized and background levels will always be higher in these waters than in other Utah streams void of the mineralized soils in their watersheds.

### 5.4.4 Summary of Human Health Evaluation

There are some potentially Extremely High Health Risks to humans from the metals at the Site based on individual soil samples taken at Pacific Mill. There are potentially Moderate to High Risks to humans in all three user groups exposed to lead in soils at Pacific Mine, Pacific Mill, Blue Rock, and Scotchman.

Surface water no longer poses any risk at any of the four sites being evaluated.

Arsenic poses a Moderate to Extremely High Risk for campers exposed to soils at the Site although of at least equal concern is the high arsenic found in the fish that campers and Day-Use visitors are consuming.

State officials have determined that none of these risks are sufficiently high to maintain health risk advisories at the sites although some warning signs placed by the Forest Service are still in place at Pacific Mine. The fish consumption advisory was in place during 2002 and 2003 but removed after additional fish tissue testing and the completion of the Removal Action in 2003.

## 5.5 ECOLOGICAL HEALTH

The second area of concern is the evaluation of ecological risk at the sites. Tables 5.11 through 5.18 show the exposure scenarios related to Deer Mice, Mule Deer, Rocky Mountain Elk, Mallards, Canadian Geese, Robins to soils and aquatic organisms/species.

### 5.5.1 Wildlife Exposue To Soils

**Table 5.11. Wildlife Risk Table for Exposure by a Deer Mouse to Soils**

| Contaminant mg/kg | | BLM Criteria | Pacific Mine | Pacific Mill | Blue Rock | Scotchman |
|---|---|---|---|---|---|---|
| Arsenic | | 230 | 402 | 3,667 | 1,709 | 97 |
| Cadmium | | 7 | <41 | No Test | No Test | <45 |
| Copper | | 640 | 275 | 2,400 | 741 | <102 |
| Lead | | 142 | | | | 1,979 |
| Zinc | | 419 | 2,509 | | 7,066 | 860 |

Shaded areas indicate that the test value at the individual site exceeds the BLM risk criteria for a deer mouse. The metals in these waste deposits present a hazard to a deer mouse from High Risk at Scotchman to Very High Risks at Pacific Mine, Pacific Mill, and Blue Rock.

**Table 5.12. Wildlife Risk Table for Exposure by a Mule Deer to Soils**

| Contaminant mg/kg | | BLM Criteria | Pacific Mine | Pacific Mill | Blue Rock | Scotchman |
|---|---|---|---|---|---|---|
| Arsenic | | 200 | 402 | 3,667 | 1,709 | 97 |
| Cadmium | | 3 | <41 | No Test | No Test | <45 |
| Copper | | 102 | 275 | 2,400 | 741 | <102 |
| Lead | | 106 | | | | 1,979 |
| Zinc | | 222 | 2,509 | 20,890 | 7,066 | 860 |

Shaded areas indicate that the test value at the individual site exceeds the BLM risk criteria for a mule deer. Except for Scotchman, each of the sites presents a potentially Very High Risk to Mule Deer.

**Table 5.13. Wildlife Risk Table for Exposure by a Rocky Mountain Elk to Soils**

| Contaminant mg/kg | | BLM Criteria | Pacific Mine | Pacific Mill | Blue Rock | Scotchman |
|---|---|---|---|---|---|---|
| Arsenic | | 328 | 402 | 3,667 | 1,709 | 97 |
| Cadmium | | 3 | <41 | No Test | No Test | <45 |
| Copper | | 131 | 275 | 2,400 | 741 | <102 |
| Lead | | 127 | | | | 1,979 |
| Zinc | | 275 | 2,509 | 20,890 | 7,066 | 860 |

Shaded areas indicate that the test value at the individual sites exceeds the BLM risk criteria for a Rocky Mountain Elk. Each of the sites present a High to Very High Risk to Rocky Mountain Elk.

**Table 5.14. Wildlife Risk Table for Exposure by a Mallard to Soils**

| Contaminant mg/kg | | BLM Criteria | Pacific Mine | Pacific Mill | Blue Rock | Scotchman |
|---|---|---|---|---|---|---|
| Arsenic | | 16 | 402 | | | 97 |
| Cadmium | | 1 | <41 | No Test | No Test | <45 |
| Copper | | 141 | 275 | 2,400 | 741 | <102 |
| Lead | | 59 | | | | 1,979 |
| Zinc | | 196 | 2,509 | | 7,066 | 860 |

Shaded areas indicate that the test value at the individual sites exceed the BLM risk criteria for a Mallard. Each of these sites presents a potentially Very High Risk to Mallards, except for Scotchman which constitutes a potentially High Risk. This is most apparent at Pacific Mine because of the beaver pond that is located on this site. The other sites are dry except for the river running by Scotchman.

**Table 5.15. Wildlife Risk Table for Exposure by a Canada Goose to Soils**

| Contaminant mg/kg | | BLM Criteria | Pacific Mine | Pacific Mill | Blue Rock | Scotchman |
|---|---|---|---|---|---|---|
| Arsenic | | 61 | 402 | 3,667 | 1,709 | 97 |
| Cadmium | | 2 | <41 | No Test | No Test | <45 |
| Copper | | 161 | 275 | 2,400 | 741 | <102 |
| Lead | | 34 | | | | 1,979 |
| Zinc | | 271 | 2,509 | 20,890 | 7,066 | 860 |

Shaded areas indicate that the test values at the individual sites exceed the BLM risk criteria for a Canada Goose. Each of these sights presents a potentially High to Very High Risk to Canadian Geese. However, geese seldom if ever use these areas.

**Table 5.16. Wildlife Risk Table for Exposure by a Robin to Soils**

| Contaminant mg/kg | | BLM Criteria | Pacific Mine | Pacific Mill | Blue Rock | Scotchman |
|---|---|---|---|---|---|---|
| Arsenic | | 4 | | | | 97 |
| Cadmium | | 0.3 | <41 | No Test | No Test | <45 |
| Copper | | 7 | 275 | | | <102 |
| Lead | | 6 | | | | |
| Zinc | | 43 | 2,509 | | | 860 |

Shaded areas indicate that the test value at the individual site exceeds the BLM risk criteria for a robin. Each of these sites presents a potentially Very High Risk to Robins. It has been noted that there is a large population of robins that nests in the vicinity of these sites.

Lead poses an Extremely High Risk to the mammals at most or all of the proposed treatment sites. In addition to these contaminants, cadmium poses an Extremely High Risk to Mallards. Unfortunately we have insufficient information about the cadmium concentrations to determine the level of risk to mammals and birds. But if the proposed action is implemented the waste materials will all be excavate and buried, thus removing them from exposure to the environment and the current receptors.

There is evidence of deer, elk and moose at the Site. Deer and moose are often observed in the Pacific Mine area. It is suspected that they all use the sites as a source of metallic salts. However, wildlife surveys have not been conducted on any species to determine the numbers present at the Site. The sites are within the normal habitat range of deer mice, mule deer, Rocky Mountain Elk, mallards, and robins. Visits to the Site in the summer (breeding season) have resulted in observations of moose, deer, elk and songbirds. Waterfowl are normally present at Tibble Fork Reservoir below the Site and have been observed on a regular basis at the beaver dams prevalent throughout the Site, particularly at Pacific. Due to the toxic nature and lack of vegetation at the individual mine sites, it is suspected that there is avoidance of the mining wastes by most species, except as noted above. The heavy metals most likely result in a sterile soil devoid of insects and worms sought as food by smaller animals and birds, and an area devoid of plants for the deer, elk, and other ungulates.

### 5.5.2 Aquatic Life Exposure to Surface Water

The following information is no longer current or representative of the water quality issues at the Site. The 2003 Removal Action performed by the Forest Service eliminated the adverse affects to water quality at the Pacific Tailings area. This resulted in a significant improvement to water quality not only in the vicinity of Pacific Mine but also to the river down stream. The metal loading from the tailings pond no longer occurs. The data presented in the following tables were characteristic of the situation before the removal action. Currently only the discharge from the adit remains unchanged so the data in that column is still representative of current conditions. The purpose of showing this data, taken from the Forest Service EE/CA for the 2003 Removal Action, is to show the worst case scenario that existed previously. If the drainage from the adit were to be diverted from its present channel and came in contact with the remaining waste rock pile at Pacific, the impacts to water quality would again increase but should never approach the problems associated with the "Flow Across Pacific Tailings" simply because the metal concentrations in the waste rock pile are much lower than was present in the tailings. So the water quality in the river should always be better than as displayed below.

**Table 5.17. Comparison of EPA Aquatic Life Acute Exposure to Water Monitoring Results**

| Contaminant mg/kg | EPA Freshwater Aquatic Life Acute Exposure | Pacific Mine Adit (2002 Average) | Flow Across Pacific Tailings (2002 Average) | NFAF Below Pacific Mine | NFAF Below Mary Ellen & Sultana Smelter |
|---|---|---|---|---|---|
| Arsenic | 850 | <5 D ... 12 T | <5 D ... 26 T | <5 D ... <5 T | <5 D ... <5 T |
| Cadmium | 3.9 | 9.7 D ... 10 T | 12 D ... 18 T | <1 D ... <1 T | <1 D ... <1 T |
| Copper | 18 | <12 D ... 25 T | <12 D ... 32 T | <12 D ... <12 T | <12 D ... <12 T |
| Lead | 82 | <3 D ... 13 T | 42 D ... 1657 T | 5 D ... 27 T | 3.1 D ... 37 T |
| Zinc | 120 | 1342 D ... 1373 T | 1165 D .. 1823 T | 61 D ... 85 T | 44 D ... 82 T |

Shaded areas indicate that the test value at the individual site exceeds the EPA standard for Acute Exposure for Freshwater Aquatic Life. Only the drainage from the mine and across the tailings exceeded standards. It can be concluded that cadmium and copper levels in the water at the Pacific Mine Adit eliminated most Freshwater Aquatic Life immediately upon exposure. Cadmium, copper and lead levels in the water at the Pacific Mine Tailings prevented most Freshwater Aquatic Life from establishing there.

**Table 5.18. Comparison of EPA Aquatic Life Chronic Exposure to Water Monitoring Results**

| Contaminant mg/kg | EPA Freshwater Aquatic Life Chronic Exposure | Pacific Mine Adit (2002 Average) | Pacific Tailings (2002 Average) | NFAF Below Pacific Mine (2002 Average) | NFAF Below Mary Ellen & Sultana Smelter |
|---|---|---|---|---|---|
| Arsenic | 48 | <5 D ... 12 T | <5 D ... 26 T | <5 D ... <5 T | <5 D ... <5 T |
| Cadmium | 1.1 | 9.7 D ... 10 T | 12 D ... 18 T | <1 D ... <1 T | <1 D ... <1 T |
| Copper | 12 | <12 D ... 25 T | <12 D ... 32 T | <12 D ... <12 T | <12 D ... <12 T |
| Lead | 3.2 | <3 D ... 13 T | 42 D ... [redacted] | 5 D ... 27 T | 3.1 D ... 37 T |
| Zinc | 110 | 1342 D ... 1373 T | 1165 D ... 1823 T | 61 D ... 85 T | 44 D ... 82 T |

Shaded areas indicate that the test value at the individual site exceeded the EPA standard for Chronic Exposure for Freshwater Aquatic Life. The drainage from the mine and across the tailings exceeded standards, as did the average lead content below Pacific Mine. It can be concluded that cadmium, copper and lead levels in the water at the Pacific Mine Adit and the Pacific Mine Tailings had eliminated most Freshwater Aquatic Life in those tributaries. Lead concentrations prior to the 2003 Removal Action would have limited the numbers and types of Freshwater Aquatic Life in the NFAF immediately below the Pacific Mine.

## 5.6 SUMMARY OF STREAMLINED RISK EVALUATION

In summary the risk to human health associated with the heavy metal concentrations found in the waste deposits at the various mine sites looked at in this Streamlined Risk Evaluation is considered to be a Moderate to High Risk. The surface flows of water at and around the present site do not constitute a risk to humans.

Ecological receptors have a High to Very High Risk from the metals in the waste deposits. Aquatic life in the North Fork of American Fork River is no longer subjected to lead concentrations that exceed the Chronic Exposure Level below Pacific Mine after the discharge from the tailings mixed with the main stream's waters. The 2003 Removal Action eliminated that water quality concern.

Aquatic life cannot survive the high metal concentrations in the water discharging from the Pacific Mine adit. The lead concentrations in the river below Pacific Mine will now support aquatic life populations in this portion of the stream. Historic sampling of the macro-invertebrates showed significant drops in the number of organisms in the stream below Pacific compared to the number found in similar stream structure above the mine. It is anticipated that these organisms will repopulate this reach of the river now that the major source of contamination has been removed. Implementing the proposed removal action will further improve and preserve good water quality in the NFAF river conducive to fish and aquatics.

## 6.0 REMOVAL ACTION OBJECTIVES

The overall purpose for undertaking this removal action and selecting a removal alternative is to address concerns regarding human health and the environment, ARARs, and the requirements of CERCLA. A more subtle purpose for this particular removal action is to expand the accomplishments achieved by the Forest Service in their 2003 Removal Action in American Fork Canyon, building on their successes, utilizing the vast investigative data log developed for AFC, and completing the restoration of impacted abandoned mine lands on the private properties containing the Pacific Mine, Pacific Mill, Blue Rock, and Scotchman #2. Trout Unlimited is championing this effort with the intention of creating a positive result and example of how conservation groups, land owners, government and industry can work collaboratively and cooperatively to accomplish watershed restoration efforts not only in AFC but throughout the western United States where abandoned mine lands are adversely impacting the environment; including important cold water fisheries.

Reducing receptor exposure, reducing contaminant levels, or both should achieve protection of human and ecological receptors from heavy metal contamination. Overall, Trout Unlimited will make every effort to use the best cost effective technology (Best Management Practices for restoring Abandoned Mine Lands) to further improve water quality to the North Fork of American Fork River. The contemplated removal action will further protect water quality in the river downstream from Pacific Mine by removing and burying contaminated mining wastes presently exposed to erosion and transport from private lands to public lands and waters. The removal action does not include any plans to treat the water being discharged from Pacific Mine to reduce the metal loadings inherent in those flows. The Forest Service project included construction of sedimentation ponds (future wetlands) that are showing good success in reducing the metal loadings in the mine drainage before it reaches the river, thus maintaining water quality conditions in the river consistent with State Clean Water Standards. The cost of certain measures and the natural processes on and near the Site that mobilizes COCs will drive site-specific, reasonably achievable alternatives.

Various approaches, and combinations of approaches, can be effective in meeting the overall objectives of this project:

1. Minimizing the leaching of metals from wastes;
2. Minimizing human inhalation and ingestion of airborne dust particles containing lead;
3. Minimizing uptake of metals by wildlife edible plants and concentration in animals;
4. Reducing exposure of the waste piles to run-on and infiltration of meteoric waters.
5. Preventing mine drainage from contacting wastes and further leaching waste piles.
6. Removing wastes deposits from the riparian zone of American Fork River.

Table 6.1 shows by mine site the opportunity to make improvements from these approaches and resolve concerns at those locations.

**Table 6.1 Opportunities for Improvement by Mine**

| | Minimize Leaching | Minimize Human Exposure | Minimize Plant Contamination | Limit Meteoric Water Contact | Reduce Contact W/ Mine Drainage | Remove Waste From Riparian Zone |
|---|---|---|---|---|---|---|
| Pacific Mine | Medium | High | Medium | High | High | N/A |
| Pacific Mill | Medium | High | Low | High | N/A | N/A |
| Blue Rock Mine | Medium | Medium | Medium | High | Low | Low |
| Scotch-man #2 | Low | High | Low | High | N/A | Very High |
| | | | | | | |

# 7.0 IDENTIFICATION AND SCREENING OF REMOVAL ACTIONS

In this section removal action technologies applicable to achieve the objectives described in Section 6 are identified and described. These technologies will be screened against selection criteria and a 'short list' of technologies will be developed. In Section 7 a list of potential removal alternatives, developed from the short list of technologies, is described and evaluated as to their effectiveness, implementability, and cost.

## 7.1 IDENTIFICATION OF TECHNOLOGIES

Potential removal action technologies that address the elevated levels of metals in the sites' soils and sediment (tailings and waste rock piles), were identified by drawing on prior experience with similar projects and a review of available literature. These removal action technologies address the affected water and soil in the three Management Units listed below.

- Management Unit 1 – Mine Discharge
- Management Unit 2 – Mine Waste Deposits
- Management Unit 3 – Mill Site Soil Contaminants

The preliminary identification of technologies discussed in this section is not all-inclusive, but rather provides an overview of relevant technologies that could be implemented to protect human health and the environment. These technologies are classified into four basic categories:

- Institutional Controls - measures that prevent or minimize public exposure by limiting access or use of impacted areas. An attractive-nuisance debris cleanup is also included in this category.
- Engineering Controls - measures, such as caps and drainage controls, implemented to minimize contaminant mobility and exposure to the environment.
- Excavation and Off-Site Disposal - excavation and disposal of contaminated material in an Off-site permitted facility.
- Treatment - destruction or immobilization of contamination by treatment of liquid wastes and/or contaminated solids.

Each technology will be preliminarily screened in this section to determine if it should be retained for further evaluation. If the technology is retained, it is included in Section 8.0 Removal Action Alternative Evaluation.

### 7.1.1 Institutional Controls

Institutional controls involve using physical barriers and/or land use restrictions to reduce the potential for exposure to material that would otherwise need to be removed or treated to protect human health and the environment. Physical barriers such as fences are easy to implement and can, in some circumstances, be protective of human health and the environment. Institutional controls are not usually effective in controlling the source or migration of contamination but instead limit exposure to contaminated materials. Some potential institutional controls include:

Debris Removal

The remaining mining debris can be considered an attractive nuisance to children and adults and would be consolidated and buried to reduce the chance of personal injury and improve the aesthetics at the Site.

There is limited evidence of mining and mining debris at the mine sites under consideration in this EE/CA. There are concrete foundations, walls, and columns at Pacific Mill. Three wooden ore loading structures protrude from the waste rock piles at Pacific Mine. A fourth loading facility exists at the Blue Rock site. A prior owner constructed a summer cabin at that site using the loading bin to form on cabin wall. There is a great deal of recent trash at that site. The land owner wants to remove that debris during any removal action taken at Blue Rock. There are building foundations and minor amounts of wooden and metal mining debris on the privately owned lands at Pacific Mine.

Given the limited remaining evidence of the historic mining in AFC, other than the waste rock piles and mill sites, it is preferable to retain as much uncontaminated and stable mining features as possible for future interpretation by Forest visitors. Therefore, the only mining related structures or debris that will be removed are those that cannot be salvaged during removal action implementation, those that pose a physical hazard due to their poor condition, and those that the land owner want removed to improve aesthetics of the area. There is a "post mining" abandoned automobile at Pacific mine that will be hauled to the waste rock pile and buried.

Fencing

Fencing would consist of constructing a fence or other barrier around the perimeter of each management unit in order to restrict access to the contaminated areas. Access to the contaminated areas would be through a locked gate only.

Road Closures

The access roads to the site would be closed with gates to help prevent unauthorized motorized access to the management units. This technique would be of limited use at Pacific Mine because the Forest Service road in the canyon passes within 300 feet of the site and the Miller Hill access road actually passes over waste rock pile at Pacific. Other closure devices such as placement of boulders or guardrails may be used to block access to roads or areas that are closed or reclaimed to protect those areas while vegetation is being established or to prevent unauthorized use of areas closed to vehicular use.

Signs

This technology involves posting restricted access warning signs around the Site and the perimeter of the different management units.

### 7.1.2 Engineering Controls

Engineering controls involve using constructed facilities to restrict the movement of soils and/or surface waters. This includes controlling percolation through contaminated materials,

runon of overland flows to contaminated areas, and the migration of contaminated soils and/or water. Some potential engineering controls include:

Capping the Contaminated Material in Place

Capping the contaminated solid materials in place could be utilized to minimize ARD (Acid Rock Drainage) generation from the existing contaminated soil and sediment. Capping minimizes the generation of ARD by reducing the contact of the contaminated materials with oxygen and water, which is needed to produce ARD from the contaminated material. Capping also reduces potential human and environmental exposure to the contaminated material.

The cap usually:

- Is at least two to three feet thick and constructed of non-acid generating material;
- Is of relatively low permeability (a soil or amended rock which has a saturated hydraulic conductivity of less than about $10^{-6}$ cm/sec, or a synthetic membrane);
- Provides protection against disturbance and erosion by the construction of an upper layer which may consist of either a 1 to 2 feet thick layer of larger non-acid generating rock, or a vegetated layer (topsoil);
- Has a surface slope of 2 percent or more to help prevent ponding and reduce infiltration of precipitation; and
- Provides drainage interception ditches to help prevent runon of surface waters.

In some cases the requirements for these cap materials can be met by using inert waste material from the mining process or other operation; more often the cover materials have to be imported or created and may include the use of synthetic liners. The use of cover material (soil) and vegetation is also an acceptable method to provide slope stability and reduce water infiltration through uptake and evapotranspiration.

Consolidating and Disposing in an On-Site Cell

Existing contaminated soil and sediment from the management units could be excavated and consolidated into a single engineered cell on the Site. The cell would be designed to minimize infiltration of rain water and snowmelt, reduce leachate generation, minimize contact with surface waters, and reduce migration of the contaminated material. The cell would be located in an on-site area where it would be as "high and dry" as practical in terms of minimizing potential contact with groundwater and surface water.

Control Runon and Runoff

Controlling runon of overland flows involves controlling the pathway of mine drainage discharged from the mine adit, and reducing surface water contact with other management units. These engineering controls include diverting runon to the permeable soils above the mine, controlling runon to the waste rock pile and tailings, and routing the mine discharge from the underground workings away from the waste rock pile. Controls would be implemented to reduce runon and prevent seasonal water drainage from contacting management units thus reducing the amount of ARD produced at the site.

Plug Mine Adit

A method of reducing the production of ARD contaminated water is to plug the mine adit. Once the adit is plugged with an impervious material, water would rise and flood the void behind the plug(s). By allowing the void space to fill with water, the generation of ARD is minimized by limiting the oxygen needed for the chemical reaction that produces ARD. Plug(s) may also serve to minimize discharge from the adit and prevent surges of water, sludge, and sediment to surface waters. This technology has had limited success at other similar sites.

### 7.1.3 Excavation and Off-Site Disposal

Excavation of contaminated soil and waste materials and hauling it to a permitted off-site disposal facility is generally an easily implemented technology that can be performed with standard equipment and construction methods. The material is loaded into haul trucks and transported to an approved commercial disposal site. The nearest identified commercial site is approximately 70 miles from the Site. However, for this project the Forest Development Roads providing access to the site would require extensive improvement at very high costs before they could be used for hauling the volume of waste needing treatment. Improvement of those roads is not consistent with the management plan adopted by the Forest Service for this watershed.

Excavation and off-site disposal are specific to the management units that have contaminated soil and/or sediment. Excavation involves removing the contaminated material from the sites by means of conventional equipment. Disposal involves the permanent placement of contaminated materials in a manner that reduces contaminant mobility and protects human health and the environment for the long term. Disposal locations are limited to those permitted facilities that can accept the concentrations of contamination in the excavated material and to those facilities willing to accept the large volume of waste this project will produce. Excavation of the contaminated materials would eliminate the contamination source from every management unit except the mine drainage from the Pacific adit.

### 7.1.4 Treatment

Treatment technologies potentially useful for treatment of ARD and soil contaminated or produced by mining operations are numerous. Because it is not feasible to destroy metal compounds and other inorganic compounds, most treatment options instead immobilize or extract these constituents. Some potential treatment technologies for the contaminated solid materials (listed first) and the ARD include:

Soil Washing

Metals in the contaminated soil and sediment from the management areas can be separated from the material by soil washing. A portion of the metals adsorbed onto the waste material are separated and concentrated in an aqueous-based system. Chemical addition (e.g., chelation) is normally required to increase desorption of metals from the soil. The process then requires precipitating chemicals to separate the dissolved metals from the wash water. This is strictly a soil volume reduction step and large volumes of treatment residuals from the soil washing require treatment or disposal.

Solidification/Stabilization

Solidification/stabilization are chemical treatment processes that reduce the mobility of the metals in the contaminated soil and sediment from the management units. Contaminants are physically bound or enclosed within a stabilized mass, or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility. Very large amounts of stabilizing material (e.g., Portland cement) and water are required. Substantial equipment would be placed on-site to store stabilizing materials, mix stabilizing material with soil and water in proper proportions, and control the process, which is similar to a concrete mixing plant. A reliable power supply and clean water supply is required. The stabilized mass would have a volume approximately 30 percent greater than the volume of the original soil and sediments being treated. The mass would be disposed on-site into an engineered cell.

Anoxic Limestone Trench or Pit

The anoxic limestone trench or pit can be used to treat ARD contaminated water. A trench or pit is designed that causes a slow release of carbonate material from limestone chips increasing the alkalinity of the water, preventing the formation of acid. If there are metals in the water, this must take place in the near total absence of oxygen so that metal precipitates do not coat the chips and stop the dissolution of carbonate. Flow through the pit or trench is designed to keep the limestone submerged continually. An anoxic limestone trench or pit is a passive ARD neutralization technology that can be used in remote locations where active treatment systems are difficult to implement.

The pH of the water draining from the Pacific Mine was tested two times in 2004 by the Forest Service in July and September. The field pH of the water was 7.1 and 6.9 respectively.
Water samples were also taken in the river and the newly constructed sediment pondsas part of the Forest Service monitoring in 2004. The pH of the river samples was between 8.2 and 8.7. The samples from the ponds ranged from 8.2 to 8.9.

There are no surface water discharges from any of the other sites included in this analysis. It is not anticipated that there is any need to increase the alkalinity of the surface waters associated with this project.

Chemical Reduction/Oxidation

The metals in the contaminated soil and sediment can be treated by chemical reduction/oxidation. Reduction/oxidation reactions chemically convert hazardous contaminants to non-hazardous, or less toxic compounds, which are more stable, less mobile, and/or inert. This purpose of this technology is to reduce the mobility of the contaminants in the soil. This process would involve the placement of substantial equipment on-site to store chemicals, mixing the chemicals with soil, separate metals from solution, and otherwise process the soil and sediments. A reliable power supply and water supply would be needed. Significant quantities of treatment sludge would be produced that would probably require off-site disposal to a commercial facility. The technology would be difficult to implement at a remote site that lacks utilities.

Diversion Well

A diversion well channels contaminated mine drainage into a pipe with a bend and a drop of at least eight feet into a cylinder filled with limestone gravel. The force of the drop of the water agitates the limestone. This can be used even where there is high metal content because the agitation of the gravel abrades any metal precipitation. This device must be refilled with gravel every one to two weeks. This technology causes precipitation of metal oxides downstream and should be utilized with a wetland having an oxidizing and then reducing environment, to remove metals and then to raise pH again. This method requires frequent maintenance and a location where a water drop of eight feet can be constructed.

Ion Exchange

Metal recovery from the ARD contaminated water could also be accomplished by ion exchange. Ion exchange removes ions from the aqueous phase by exchange with innocuous ions on the exchange medium. The metals are extracted in a concentrated form that can be recycled. This treatment requires extensive support and maintenance every few days.

Oxic Limestone Trench

Oxic limestone trenches are used when the metals in the ARD discharge is low. In this case, trenches can be left open so the consumption of limestone can be monitored and the trench refilled as necessary. Use of such a trench by the Pennsylvania Electric Company indicates the useful life before a refill to be five to ten years (SCRIP, 1998). This process, as well as some of the other oxic and anoxic systems, have limited success in the western United States due to the normally high iron and aluminum content which precipitates and armors the limestone surfaces. These systems are often compromised by high precipitation events and spring snowmelt/runoff.

Oxidizing Wetland

Oxidizing wetlands precipitate metals from ARD contaminated water as a result of oxygenation. These wetlands consist of shallow pools of water with a large surface area that permits the absorption of oxygen by the water. Slowing the movement of water down and allowing sufficient detention time before the mine drainage gets to the stream allows large amounts of the metals to be removed. However, oxidizing reactions have the serious drawback of producing more acid and further lowering pH, which would need to be raised before release.

This approach was put into practice at Pacific Mine. The tailings pond was located in the riparian zone of the North Fork of American Fork River. Groundwater saturated the tailings to within about a foot of the surface. Removal of the tailings was followed by restoration of the riparian zone. A series of 6 ponds were constructed in the lowlands that were created by backfilling the excavated mill tailings pond. These lowlands and ponds will eventually result in wetland soils and vegetation if they are maintained properly over time.

The Forest Service monitored the water discharging from the Pacific adit that was routed through the newly constructed ponds. The results have been very encouraging. For instance, the zinc concentration in the water immediately outside the adit was 2,500 ppb while the water discharging from the ponds into the river had zinc at 23 ppb. The pH of the water actually became more basic going from 7.1 at the adit to 8.7 after passing through the ponds. This is probably attributable to the glaciated limestone that constitutes most of the reclaimed lowlands.

Permeable Reactive Wall

A passive reactive wall has been used to treat ARD contaminated ground water in aquifers affected by mine waste materials. The reactive wall would treat the groundwater by directing the water through a reactive mixture containing organic matter designed to promote bacterially mediated sulfate reduction and subsequent metal sulfide precipitation.

Precipitation

Metals from the ARD contaminated water could be removed by precipitation with the addition of lime or other pH-raising chemicals. Metals precipitation involves the conversion of soluble heavy metal salts to insoluble salts that will precipitate. The precipitate can then be removed from the treated water by physical methods such as clarification and/or filtration. This would be a high maintenance system requiring daily operator attention and a continuous power supply.

Reducing Wetland

Reducing wetlands are a passive treatment system in which ARD contaminated water is passed through a reducing environment, causing the sulfates in the flow to be reduced to metal sulfides using biologically mediated reactions. Reduction occurs in the organic material collected at the bottom of the wetland (substrate) and involves reactions, which remove oxygen from the metals (reducing) and cause them to be extracted in the sediment of the basin. The wetland generally consists of a substrate of composted organic material to achieve the reducing conditions necessary. It may also include limestone within the compost to also create a passive neutralization component. Reducing wetlands are generally only applied for low volume flows such as at Pacific Mine, due to the considerable acreage required for successful long-term application. A general rule of thumb is that each one gallon per minute of flow requires approximately 800 square feet of wetlands (Wildeman, 1993).

## 7.2 PRELIMINARY SCREENING OF TECHNOLOGIES

The objective of this section is to screen the potential removal action technologies discussed above in Section 4.1 and eliminate those actions that do not meet the preliminary screening criteria. These criteria will be used to evaluate the potential removal action technologies in order to develop a short list of technologies. These screening criteria are based on site or regulatory conditions that preclude a certain technology from being implemented at the Site. The criteria selected for preliminary screening include:

- Technical feasibility
- Administrative feasibility
- Maintenance requirements
- Availability of services and materials

These criteria are further defined in the following sections. Removal action technologies that do not meet these preliminary screening criteria will be removed from further evaluation. The list of identified remediation technologies is provided in Table 7-1 along with the screening criteria. Further consideration is given to each technology's suitability as "Supportive of Future Removal Actions". This factor is not used to eliminate any alternatives from consideration for the reasons explained in subsection 7.2.5.

## TABLE 7-1 REMOVAL ACTION TECHNOLOGY PRELIMINARY SCREENING MATRIX

| Technology | Technical Feasibility and Implementability | Administrative Feasibility | Maintenance Requirements | Availability of Services and Materials | Supportive of Future Removal Actions |
|---|---|---|---|---|---|
| **Institutional Controls** | **Good, Average, Poor** | **Good, Average, Poor** | **High, Medium, Low** | **Good, Average, Poor** | **Good, Average, Poor** |
| Debris Removal | Good | Average | Low | Good | Good |
| Fencing | Good | Average | High | Good | Good |
| Signs | Good | Average | Medium | Good | Good |
| Road Closure | Poor | Poor | High | Good | Poor |
| **Engineering Controls** | | | | | |
| Capping Contaminated Material in Place | Average | Average | Medium | Average | Good |
| Consolidation, Disposal in an Onsite Cell | Good | Good | Low | Good | Poor |
| Control Runon & Runoff | Average | Good | High | Good | Good |
| Plug Mine Adit | Poor | Good | Medium | Good | Good |
| **Excavation and Disposal** | | | | | |
| Excavation, Off-Site Disposal | Poor | Poor | Low | Good | Good |
| **Treatment** | | | | | |
| Solidification/Stabilization | Poor | Poor | Low | Average | Good |
| Soil Washing | Poor | Average | Low | Poor | Good |
| Anoxic Limestone Pit or Trench | N/A | Average | Medium | Average | Good |
| Chemical Reduction/ Oxidation | Poor | Average | Low | Poor | Good |
| Diversion Well | N/A | Good | High | Average | Good |
| Ion Exchange | Poor | Poor | High | Poor | Good |
| Oxic Limestone Trench | N/A | Good | Medium | Average | Good |
| Oxidizing Wetland | Good | Good | Medium | Average | Good |
| Permeable Reactive Well | Poor | Average | Medium | Average | Good |
| Precipitation | Poor | Poor | High | Average | Good |
| Reducing Wetland | Good | Good | Medium | Average | Good |

### 7.2.1 Technical Feasibility and Implementability

Due to the characteristics of the Site including; the remoteness of the area, the lack of utilities, and no winter access due to heavy snow packs, some of the technologies may not be feasible or applicable for this Site. Any removal action technology that requires improved roads, permanent power utilities, continual oversight, has not been proven, etc., will not be technically

feasible nor can be reasonably implemented. The following technologies were not retained because they did not meet the technical feasibility criteria:

Plug Mine Adit

The adits for the mines under consideration in this EE/CA have already been closed. Only Pacific Mine, which is closed, produces discharge through two drainage pipes installed at the time of closure. This flow is sufficiently large and constant that plugging it would be difficult and would probably just result in the discharge surfacing at another location in the canyon through the fractured rock formation associated with the fault exploited by the mining.

Plug Vertical Shafts

There are no open vertical shafts at the mine sites being evaluated by this EE/CA.

Excavation, Off-Site Disposal

Off site disposal would require the reconstruction of the road from Holman Flat to Pacific Mine through the switchbacks and narrows. The cost of the road construction is prohibitive. Furthermore improving the road to a standard suitable for this type and volume of haul would have the affect of changing the nature of the canyon by allowing far more vehicles of various types to use the road. This would create conflicts with the management practices preferred for this area by the Forest Service. (To demonstrate the infeasibility of this technology for this application further discussion of this method is presented hereafter as Alternate X.)

Soil Washing

Washing soil to remove contaminants requires large quantities of water and power, and produces large volumes of contaminated sludge and contaminated water requiring treatment. There is no power supply to the site. This technology would not be cost-effective at this location.

Solidification/Stabilization

Solidification of the contaminated material would require transportation of the solidification material to the Site. The required solidification material volume is approximately one third of the contaminated material to be solidified. Significant water supply and power are required. This process greatly increases the volume of waste to be disposed (e.g., into an on-site cell). There is no power supply to the site. Overall, it is not cost-effective for this location.

Anoxic Limestone Pit or Trench

This approach is intended to raise the pH of the ARD. The site does not have acidic waters, but they exhibit elevated concentrations of heavy metals. This approach is not applicable.

Chemical Reduction/ Oxidation

Chemical reduction/oxidation requires the placement of substantial equipment on-site to store chemicals, mix chemicals with soil, separate metals from solution, and otherwise process the soil and sediments. A significant power supply is needed. The sludge produced would probably need expensive off-site disposal. There is no power supply on site. The technology would be difficult to implement at this site and would not be cost-effective.

Diversion Well

This approach is intended to raise the pH of the ARD. The site does not have acidic waters, even though they exhibit high concentrations of heavy metals. This approach is not applicable.

Oxic Limestone Trench

The oxic limestone trench is typically used for contaminated water with low concentrations of metal, which is not the case at this site.

Permeable Reactive Wall

A permeable reactive wall is designed to remediate groundwater aquifers. The groundwater pathway at Pacific Mine is not well defined. Because the ground water saturates most of the tailings and the river is immediately adjacent to the tailings, this technique is not considered feasible.

### 7.2.2 Administrative Feasibility

Any removal action technologies that do not coincide with the land owners goals and objectives for the project area will not be administratively feasible and will be removed from further consideration during the preliminary screening. The following technology was removed because it did not meet the administrative feasibility criteria:

Road Closure

Closing the access road to the site would eliminate vehicular access to thousands of acres of public and private lands. It can be anticipated that eventually more restrictions will be placed on public use of private lands in AFC. However in the project area the Forest Service roads which will remain open to public use are within 50 to 300 feet of the management units being considered for treatment. Road closures would be marginally affective in reducing human exposure to contaminated materials at these sites and would not benefit the other environmental receptors which are being exposed. Road closure will not be used as a removal action application. However, closure of short segments of roads may be included as part of the reclamation of the individual sites such as Blue Rock and the reclaimed borrow area. All temporary roads constructed for this project will be closed and reclaimed.

### 7.2.3 Maintenance Requirements

Due to the remote location of the Site, potential bad-weather inaccessibility, and funding issues, it would be very difficult to provide regular significant maintenance for any removal action

technology implemented at the Site. Therefore, technologies that are considered should have minimal or no maintenance requirements. Any removal actions that require regular frequent maintenance and operational oversight will be removed from consideration during the preliminary screening. For example; a waste water treatment plant for the ARD would require daily oversight, the addition of chemicals, sludge removal, etc., and would therefore not be an acceptable technology. The following technologies were removed because they did not meet the maintenance requirements:

Diversion Well

The diversion well must be refilled with limestone gravel every one to two weeks; therefore, it is not an appropriate remedial technology.

Ion Exchange

The ion exchange treatment requires extensive support and maintenance to operate.

Precipitation

Treatment of the contaminated water by precipitation also requires extensive maintenance and support, including sludge removal.

### 7.2.4 Availability of Services and Materials

Many technologies that may be reasonably implemented at other sites would be difficult in American Fork Canyon due to the lack of local services and materials. For example, it may not be feasible to construct a clay cover if there is not a source of clay within a reasonable distance from the Site. The preferred removal action technologies will most likely be simple in nature and can be accomplished with local equipment and expertise. Any technology requiring services and/or materials that are not reasonably attainable in the local area will be screened out and will not be evaluated further.

All of the technologies that were rated poor for the availability of services and materials in Table 7-1 have already been eliminated under one of the previous screening technologies

### 7.2.5 Supportive of Future Removal Actions

Most of the technologies considered are conducive to removal actions at the large number of mine sites and wastes on private property or in remote areas on NFS Lands. Consolidation and Disposal in an Onsite Cell is rated as poor because once the disposal cell is constructed, covered and revegetated further disturbance (or adding of additional waste to the cell) would be discouraged. This rating reflects the inflexibility of this application for disposal of other mine wastes in this cell. However, this project removes all the mining wastes on the land owners property in close proximity that could be reasonably utilized for disposal of wastes at the proposed repository site. The other wastes on private lands in the canyon are located in remote areas with roads inadequate for use by haul trucks to carry additional wastes to the repository. Therefore, this alternative is not eliminated from further consideration for this project.

## 7.3 SUMMARY OF RETAINED REMOVAL ACTION TECHNOLOGIES

The potential removal action technologies presented in Table 7-1 were screened utilizing the above criteria and the retained technologies are provided in Table 7-2. The applicable management units that are addressed by the retained removal action technologies are also identified.

**TABLE 7-2 RETAINED REMOVAL ACTION TECHNOLOGIES**

| REMOVAL ACTION TECHNOLOGY | APPLICABLE MANAGEMENT UNIT(s) |
|---|---|
| Fencing | All Management Units |
| Signs | All Management Units |
| Capping Contaminated Material In-Place | Waste Rock Pile, Tailing Ponds |
| Consolidating and Disposing in an Onsite Cell | Waste Rock Pile, Tailing Ponds |
| Control Runon and Runoff | Mine Drainage, Waste Rock Pile, Tailings Ponds |
| Debris Removal | All Management Units |
| Oxidizing Wetland | Already In Place from 2003 Removal Action |

## 7.4 DEVELOPMENT OF ALTERNATIVES

The Removal Action Technologies identified in Table 7-2 above are the basis for identifying specific Alternative Removal Actions to be considered and evaluated for use in the American Fork Canyon project. The formulation of alternatives process is explained hereafter. Some of the Alternatives incorporate two or more of the implementable technologies.

Specific objectives at each of the five mine locations being contemplated for removal actions under this project are:

- Pacific Mine
  - Stabilization of the contaminated soils in the waste rock pile
  - Reduce receptor exposure to contaminated materials
  - Reduction of leaching of heavy metals from the waste to surface water
  - Relocate the Miller Hill road from off the top of the waste pile
  - Prevent transport of contaminated materials from the private property onto NFS lands by natural or man made causes
- Pacific Mill
  - Reduce receptor exposure to contaminated materials
  - Stabilize the contaminated soils in the mill site
  - Remove unstable concrete structures in the mill site
- Blue Rock
  - Stabilization of the waste rock pile
  - Reduce receptor exposure to contaminated materials
  - Reduction of leaching of heavy metals from the waste to surface waters

- Scotchman No. 2
    - Stabilization of a waste rock pile
    - Reduce receptor exposure to contaminated materials
    - Reduction of leaching of heavy metals from the waste to surface waters, and eliminate contact of the waste materials with the river

Implementation of the technologies retained in Section 7.2 will accomplish some, or all, of the specific objectives for the mines under consideration.

- Technology 1 - Institutional Controls to Limit Access Including Fencing, Barriers, Signs, and Gates
- Technology 2 - Excavation, Consolidation, and Disposal of Contaminated Materials in Onsite Cell
- Technology 3 - Capping Contaminated Materials in Place
- Technology 4 - Excavation and Disposal in an On-Site Facility
- Technology 5 - Control Runon and Runoff
- Technology 6 – Debris Removal to Eliminate Hazards and Attractions

The following alternatives are derived from the technologies listed above and will be evaluated for potential implementation in Section 8 of this document:

- Alternative 1 - Institutional Controls to Limit Access Including Fencing, Barriers, Signs and Gates
- Alternative 2 – Excavation, Consolidation, and Disposal of Contaminated Materials in an On-Site Engineered Cell (Repository)
- Alternative 3 – Capping Contaminated Materials In Place
- Alternative 4 – Engineering Controls to Minimize Runon and Control Runoff of Surface Water at Waste Stockpiles

Limited discussion also follows for another alternative listed as "Alternative X – Excavation and Disposal in Permitted Off-Site Facility". Although this alternative is removed from consideration is Section 7.2, some information concerning this application follows to further explain why it was eliminated and demonstrate the inordinately high cost associated with this application. Because of the limited discussion of this alternative it is listed as Alternative X to differentiate it from the other alternatives being considered for implementation.

# 8.0 REMOVAL ACTION ALTERNATIVE EVALUATION

The removal action technologies were preliminarily screened in Section 7.2 based on select criteria and a short list of applicable technologies was developed. In this section a list of removal action alternatives is defined and evaluated with respect to the criteria of effectiveness, implementability, and cost.

## 8.1 DESCRIPTION OF PRELIMINARY REMOVAL ACTION ALTERNATIVES

Several retained removal action technologies (Table 7-2) were identified that may be utilized at the Site. The removal action alternatives presented below were developed from this list of retained technologies and may consist of one or more technologies. For instance, Alternative 1 consists of the following technologies; fencing, barriers, signing, and gates. A description of each alternative is provided below.

### 8.1.1 Alternative 1 - Institutional Controls to Limit Access Including Fencing, Barriers, Signs, and Gates

The objective of this alternative is to prevent exposure and injury by restricting access to the contaminated material and unstable structures at the sites. Because of the heavy snow packs and high ATV use in American Fork Canyon fences are only effective for short-term applications. Fences are subject to damage from vandalism and being crushed by heavy snow packs. For long-term applications more substantial barriers resistant to vandalism and collapse from snow loads are needed. For this project, access to the contaminated material would be restricted by a combination of barriers and signs. Each contaminated area would have a restricted access barrier. The estimated length of barriers to enclose each area is shown in Table 8-1.

**TABLE 8-1. ESTIMATED LENGTH OF BARRIERS FOR ALTERNATIVE 1**

| MINE AREA | ESTIMATED LENGTH OF BARRIER |
|---|---|
| Pacific Waste Rock Pile | 800 feet W-beam guardrail |
| Pacific Mill Site | 200 feet |
| Blue Rock Mine Site | 100 feet |
| Scotchman #2 Waste Rock Pile | 100 feet below and 100 feet above the pile |
| Borrow Area – Used with Alt. #2 | 300 feet of temporary barrier |
| TOTAL | 1300 feet of permanent barrier<br>300 feet of temporary barrier |

This removal alternative would reduce the potential of human exposure through direct contact, inhalation, and ingestion; however, it will not minimize exposure to the environment or reduce the toxicity of the contaminated materials.

This technique was utilized by the Forest Service in combination with other alternatives at Pacific and at the Dutchman Flat repository. Many dispersed camping areas on NFS lands

between Dutchman Flat and Pacific Mine are delineated and controlled by barriers consisting of post and pole fences or rock barriers utilizing medium sized boulders. Some of these locations have barriers, fences, combinations of both and signs prohibiting ATV's and other vehicles from entering these locations. At Pacific, a W-beam guardrail barrier with 3 signs was installed by the Forest Service in 2000 prohibiting entry to the tailings and waste rock pile on NFS Lands. The guardrail barriers were retained after the 2003 removal action but new signs were installed discussing the mine reclamation efforts and prohibiting vehicle use on the restored areas. In 2001 the private land owner at Pacific installed a post and pole fence around the waste rock piles on private property further eliminating public access to the contaminated areas. The barrier on NFS Lands also encloses the mine drainage channel however the channel from the adit to the property boundary (200 feet on private property) is still accessible to recreationists and their vehicles. The main road providing vehicular access to private parcels and NFS Lands on Miller Hill crosses the Pacific waste rock pile on private property next to the land owner's fence. Two sections of the fence have been vandalized where someone used an axe to cut through the poles to gain vehicular access to the waste piles. Figure 3 is a photo of the guardrail and sign on NFS Lands after the Dutchman Repository was finished.

**Figure 3 - Existing Barrier and Sign at Dutchman Repository**

At Dutchman Flat the Forest Service installed a post and pole fence with signs in 2001 prohibiting entry to the waste rock piles, tailings pond, and mill site. A section of the pole fence was torn out by ATV users shortly after it was installed and some vandalism of the sign occurred. The fence was repaired and significantly reduced the number of ATV's being operated on the contaminated areas. This fence was considered a short-term solution to minimize the exposure of human receptors to the hazards associated with this site and functioned well for the 2 years it was in place. The fence was removed during the 2003 removal action and replaced by a W-beam guardrail after the disturbed site was converted to a repository. New signs were installed to inform the public about the repository and prohibit

vehicular use on the repository. There were no indications of improper use or vandalism at the repository during the 2004 field season.

The Forest Service installed a rock barrier to prevent vehicular use of the reclaimed land at Sultana Smelter in 2003. The rock barrier has proven less effective than the guardrail barriers. Individual boulders were moved by recreationists so they can drive their vehicles onto the reclaimed area where they like to camp next to the river. The boulders were replaced several times by the Forest Service and others but there were continued occurrences of public encroachment onto the treated area with their vehicles.

Presently there are no constructed barriers or signs to limit access to the contaminated materials at Pacific Mill Site, Blue Rock Mine, or Scotchman Waste Rock Pile.

If this alternative were selected for a long-term application at all sites the more substantial, vandal resistant, snow pack resistant barrier would be used. At the Pacific waste rock pile a guardrail barrier with signs could be constructed around the perimeter of the contaminated material. To maximize the benefits of this application at Pacific would require other measures to move the Miller Hill access road off of the pile onto uncontaminated soils or to place a running surface for the road over the contaminated waste at the present roadway location.

At Pacific Mill a barrier and sign could be installed at the base of the hill where the mill was located. These appurtenances would alert the public to the potential hazards associated with the mill site and discourage entrance by the public. At Blue Rock the barriers would be some distance from the waste rock pile blocking roads and trails accessing the site. Additional signing would be installed on the waste rock pile addressing the potential hazards at that site. At Scotchman #2 a barrier could be installed along the top of the pile on the shoulder of the Miller Hill access road. Signs would be installed at the barrier and at the toe of the pile, just above high water line for the river, to inform recreationists using the dispersed camping area next to the river of the heavy metals in the waste rock pile. It is noted that vehicular use does not occur on the hillside at Pacific Mill or the waste rock piles at Blue Rock or Scotchman because of the steepness of those areas. Barriers would increase the awareness of the recreationists exploring those sites but would not prevent them from crossing the barriers and entering the sites.

In the event that a repository is constructed at Pacific (Alternative 2), barriers and signs would be an integral component of that application to prevent vehicles from being operated on the gentle slopes and top of the repository. Signs would prohibit that vehicular access and would inform the public about the storage of mining wastes in the repository.

Constructing the barriers would be relatively simple and could be quickly implemented. Associated costs include the initial labor, materials, and periodic inspection and maintenance. An advantage of this alternative is the relatively low cost and simple implementation compared to other alternatives. However, this alternative does not reduce the volume of contaminated material nor eliminate the source of contamination. The wastes would continue to be expsosed to erosion from wind or water. Wildlife would be able to use these areas at will while being exposed to the heavy metals in the soils.

### 8.1.2 Alternative 2 - Excavation, Consolidation, and Disposal of Contaminated Materials in an On-Site Engineered Cell (Repository)

During preliminary site investigations of these mines the Forest Service was contemplating partnering with EPA to remove not only the waste materials from NFS Lands but also the private lands at Pacific and elsewhere. The combined project proposed developing a common repository for deposition of wastes from all the various sites. During those investigations topographic surveys of the waste deposits and potential repository locations were accomplished for the Forest Service by the United States Bureau of Reclamation. The quantities represented in this analysis are representative of those surveys.

The objective of this alternative is to excavate contaminated materials from the waste rock piles and mill site, hauling it to a central location, and depositing it for containment in an engineered cell. This would minimize exposure of the materials to the environment by: minimizing infiltration and the resulting leachate; reducing migration of the contaminated material; and minimizing contact with surface waters. In addition, the cap over the cell would reduce the possibility of human exposure through direct contact, inhalation, and ingestion. This alternative would not reduce the toxicity nor volume of the contaminated materials but it would consolidate it at one maintainable site. The total estimated volume of these materials is about 24,500 cubic yards as broken down below in Table 8.2

**TABLE 8-2. ESTIMATED VOLUMES FOR ALTERNATIVE 2**

| MANAGEMENT UNIT | ESTIMATED VOLUME (cy) |
|---|---|
| Pacific Waste Rock Pile | 20,000 |
| Pacific Mill Site | 500 |
| Blue Rock Waste Rock Pile | 3,000 |
| Scotchman #2 Waste Rock Pile | 1,000 |
| **TOTAL** | **24,500 cy** |

Locating the repository at the Pacific waste rock pile will allow incorporating approximately 16,500 cubic yards of waste rock into the repository without having to move them. Only 3,500 cubic yards of the Pacific pile would be moved to reshape the pile and flatten the slopes to a 3:1 to facilitate placement and retention of a soil cap or cover. This is a significant advantage to having the repository sited elsewhere because it eliminates the cost of moving 2/3 of the total waste being addressed by this proposed Removal Action.

There is one other potentially suitable site on the land owner's property for locating a repository. That location is up canyon from Pacific about ¼ mile in the "flat" where the borrow material will be obtained for the soil cap for the repository. This potential site has not been examined for ground water – no wells have been installed at this site - but the site appears dry and suitable for disposal of the waste materials. Using this alternative site would increase the cost of the removal action by a factor of 3 to 4 times the cost of constructing the repository at the Pacific waste rock pile. Not only would the alternative location for the repository require

the excavation and movement of another 16,500 cubic yards, it would increase the haul distance to the repository from each of the sites to be treated. The alternative repository site would have to be prepared to receive the waste materials. That would require the excavation and stockpiling of at least 3,500 cubic yards of material that would be used to cover the repository. The stockpile area would require additional ground disturbance which would have to be reclaimed. Another deterrent to using the borrow area for the repository is that this "flat" is one of very few locations on the landowners property near the Pacific location that has high develop potential, perhaps as a cabin site. Placing the repository here would eliminate the opportunity for other uses in the future.

Because of the significantly reduced costs associated with placement of the repository at the present Pacific waste rock pile, Alternative 2 will consider this location as the repository site for further discussion and evaluation in this document.

Construction of the repository at Pacific would involve the following steps:

- Locate the cell in an area that is best situated to minimize exposure to the public, surface water, and groundwater flow; the location should be as 'high and dry' as possible. Design of the repository would incorporate as much of the Pacific pile into the final cell as possible without having to move those materials. However, some material will have to be moved along the face of the existing pile to flatten the slopes to a 3:1 and to provide a "contaminant free corridor" for relocation of the Miller Hill access road from off the top of the pile to the toe of the pile. Because of the proximity of the road at the toe of the repository, barricades and signs will be placed along the toe of the repository to prevent ATV's and other vehicles from being operated on the repository.

- Materials excavated and imported into the repository from Pacific Mill, Blue Rock, and Scotchman will be placed at the south end of the repository and on top of the Pacific waste materials. Large features that will be placed in the repository such as concrete bases removed from the mill site, timbers from loading chutes at Pacific and Blue Rock, and an abandoned, demolished automobile at Pacific will be buried in the top of the repository will at least one foot of fine waste material covering them. No objects will protrude from the top of the repository. Finally another 3 feet of cover material will be placed as a cap over the entire repository.

- The borrow material needed to cap the repository will be excavated from the borrow area ¼ mile up canyon from Pacific. The borrow area will be stripped of topsoil which will be stockpiled for use in reclaiming the borrow area. The excavation of the borrow area will be designed to create a reclaimed site that will blend with the adjacent terrain and enhance the area for future use by the land owner.

- The sites to be treated will be excavated by removing the contaminated materials down to the native soil interface, or until the contaminant concentrations are below predetermined levels. Verification sampling would be performed in the excavated areas to ensure that the remaining material meets the cleanup standards (indicated by Pb concentrations below 1500 ppm). The contaminated materials would be excavated with an excavator/trackhoe, loaded into trucks, and transported to the disposal cell.

- Upon arrival at the disposal cell, the contaminated materials would be spread using a dozer and compacted in the cell by "track walking" the material in order to minimize volume and future settlement. It may be advantageous to import the Pacific Mill materials initially so the larger concrete bases can be buried as the materials from the other sites are brought into the repository. The volume of the engineered cell can be easily modified by raising or lowering the elevation of the top of the cell at the time of waste placement to accommodate the actual volume of the waste material from the various sites.

- After the waste has been placed and verification sampling completed, the waste would be covered with a low-permeability cap. The cap would be designed to promote drainage from the top of the cap back toward the mountain side, minimize infiltration, and provide a base for vegetation. Drainage channels would be constructed around the upper perimeter of the cell to divert runon and direct runoff from the cell surface. Permanent barricades and signing will be installed around the repository to discourage use of ATV's in this area.

- Each of the disturbed sites will have seed, fertilizer, and mulch applied at a specified rate to promote vegetative growth on each of the sites. At the Pacific Mill site the treated area would have an erosion control blanket placed over it such as jute netting or other erosion deterrent fabric.

Consolidation into an engineered cell is a proven removal action, is relatively easy to implement, and could be performed in a timely manner. If the disposal cell is properly constructed and maintained, the cell would effectively isolate the waste from the environment. The advantage of on-site consolidation and disposal over off-site disposal is the cost savings realized from minimal transportation or disposal fees required at registered hazardous waste landfills. Before the wastes could be hauled to an off-site disposal area approximately 1 mile of canyon road would have to be reconstructed in the narrows area through bedrock formations with slopes exceeding 150%. Adding the cost of hauling the materials to an approved commercial disposal cell (approximately 70 miles one way) and disposal fees of nearly $300 a cubic yard, these costs would be prohibitive at approximately $7,000,000. (Based on quotes from Safety Clean Green Mountain Disposal Facility.)

The advantage of this alternative over capping the material in place is that the disposal cell could be located in an on-site area that is well suited for a permanent repository. It is really not practical to consider placing a cap over the Pacific Mill, Blue Rock, or Scotchman sites. The terrain at those locations is so steep that reshaping the contaminated materials to establish slopes flat enough to allow placement of a stable soil cap is not feasible. Furthermore the toe of the Scotchman pile is in the water of the North Fork of American Fork River and the Blue Rock waste form the bank of an intermittent stream. Placement of material over these sites would result in deposition of materials in active streams and drainages. This of course is not considered an acceptable practice.

The advantages of this alternative to an alternative that only utilized institutional controls such as barricades and signs are apparent in that the contaminated material is buried and removed from contact with the environment, wildlife, and humans. The potential for a release of hazardous substances from the sites is eliminated except at the repository, but even there the potential for a release from occurring is greatly reduced unless the cap is compromised.

The drawbacks to creating a repository are that all of the contaminated material at the various sites would need to be excavated and transported on site to the cell; verification sampling will need to be performed to ensure complete removal of highly concentrated contaminants; and some long-term maintenance would be required. Regular inspections of the disposal cell cap, drainage structures, and ATV barricades and signing would need to be performed to evaluate the integrity of the cap and the performance of the drainage structures, and to affect repairs as needed through perpetuity.

The cell will contain 4,500 cubic yards of imported waste and 20,000 cubic yards presently located at Pacific waste rock pile. The repository will be approximately 0.5 acres in size. The Pacific site is of sufficient size to contain such a cell, is located on a bench 20 feet or more in elevation above the river, and eliminates the need to move about 16,500 cubic yards of waste material in the Pacific waste rock pile. The proposed site has no ground water within 20 feet of the bottom of the repository as evidenced by the monitoring of the ground water in the well installed at this location in 2001.

### 8.1.3 Alternative 3 - Capping Contaminated Materials In Place

This alternative would cap in place the waste rock piles at Pacific Mine, Blue Rock, and Scotchman and the contaminated soils at Pacific Mill. A key component of the proposed Removal Action is to limit the negative impacts that precipitation and surface waters have on the contaminated materials. Capping the wastes in place should result in minimizing exposure of the materials to the environment by: minimizing infiltration and the resulting leachate; reducing migration of the contaminated material; and minimizing contact with surface waters. In addition, the caps would reduce the possibility of human exposure through direct contact, inhalation, and ingestion. This alternative would not reduce the toxicity or the volume of the contaminated materials.

A conventional cover of imported, contaminant free soil could be placed over the Pacific waste rock pile after it were reshaped and properly prepared. However, that sort of cap is not feasible at the other three sites. The terrain and piles are simply to steep to allow placement of a soil cap capable of containing the contaminated materials at these areas. If capping in place were proposed at these three sites, the cap would have to be of special material that would be stable on those steep slopes. The caps would also need to be impervious to prevent the percolation of water through the caps onto and through the underlying wastes.

If this alternative were implemented at each of these units, it should be recognized that the relative size of the capped deposit at Pacific would be approximately the same size, area, and shape as would be the repository constructed at this same site using Alternative 2. The only difference at this site would be in the top elevation of the finished site which would be some 10 feet lower because there would be 4,500 cubic yards less material in the capped pile. Recognizing this small difference at Pacific Mine raises the question of why would anyone propose capping the other sites in place rather than consolidating those wastes at Pacific in a repository. This concern is amplified when one considers the complexity of capping the other sites in place.

Because of the steepness of the other sites, the cap would have to be constructed of interlocking materials such as a rock layer of angular rock with a minimum size of about 1

cubic foot. To use this application at Blue Rock or Scotchman would require constructing some sort of retaining wall at the toe of those deposits to prevent the rock from encroaching into the streambed or river. It would be possible to install this type of cap at Pacific Mill but the complexity increases when an impervious membrane is introduced into the cap to prevent infiltration of precipitation. A high density polyethylene membrane could be placed over each of these areas but to do that effectively at Pacific Mill would require the removal of the concrete bases and pedestals on the site.

Even after properly constructing such a cover at these three locations, the confidence level in the stability of the cover would be of concern. The impervious membrane would introduce a slip plane that even the rock might eventually slip away from.

Another feasible material or application that could be implemented to cap these three sites in place would involve a material such as a gunnite application. After the sites were properly prepared the gunnite would be sprayed onto the slopes to form a solid concrete cap. The cap would have to be of sufficient depth to keep it stable in the event that people or animals crossed the material or even more demanding, if a tree were to fall onto it.

Though feasible, the rock cap and the gunnite applications are not considered reasonable alternatives. It would be difficult to obtain sufficient quantities of rock to cover these slopes. The geomorphic formations in the upper reaches of the North Fork are either glaciated deposits or bedrock. The glaciated deposits have high percentages of rock in them but the rock is generally rounded rather than angular. The size of the rock varies from cobble to small boulders. To obtain the needed quantity of rock (approximately 1,000 cubic yards) would require "mining" of a large area of glaciated deposits. It is unlikely that a suitable site for this effort could be found on the land owner's property and disturbance of that much land on NFS lands would be discouraged by the Forest Service as the environmental impacts could outweigh the benefits realized in capping of the piles.

Importing the rock and the gunnite from off the Forest would necessitate improving the road up the North Fork. The cost of those road improvements is another disadvantage of pursuing an alternative to cap the materials in place.

Permanent barricades and signs would be installed at each of the four locations after they were capped as noted in Alternative 1. Because the sources would be isolated from the environment after they were caped in place, this alternative would protect receptors long-term. This is an advantage over Alternative 1 which would result in the sources still being exposed. Low-permeability caps are a proven technology that can be readily implemented and could be performed in a timely manner. The advantage of capping the material in place, over the off-site disposal is the cost savings realized from reduced transportation expenses and elimination of the disposal fees. There does not appear to be recognizable advantages of this alternative in comparison to consolidation of the wastes and containment in one properly located repository.. Disadvantages of this alternative are that the material is left in areas that are not ideal for final disposal and may be adversely impacted by surface water and groundwater flow, especially during heavy snowmelt and spring runoff flooding. This alternative would result in 4 individual and separate capped waste piles that will have to be managed and maintained indefinitely as waste disposal areas compared to operating and maintaining one repository under Alternative 2.

### 8.1.4 Alternative 4 - Engineering Controls to Minimize Runon and Control Runoff of Surface Water At Waste Deposits

The first objective of Alternative 4 would be to remove the potential for mine drainage from the Pacific adit from being diverted into a channel along the edge of the mining wastes at Pacific. As noted previously both UDOG and the land owner have implemented measures to direct the mine drainage away from the contaminated deposits. With minimal effort, as simple as placing a 15 inch by 15 inch piece of plywood over the inlet to a 12 inch diameter pipe, the mine drainage could be easily diverted from its current path back to a location along the toe of the remaining waste rock pile. By connecting the two 6 inch pipes discharging water from the adit to the 12 inch culvert, and then burying the culvert connection with soil, will prevent the water from being diverted from the channel which carries the water away from the waste rock pile.

In the event that Alternative 2 is not incorporated in the removal project and the waste rock is not capped at Pacific, overland flow interceptor ditches can be constructed using "clean materials" to divert any overland flows from coming into contact with the waste materials.

Pacific Mill does not have established channels entering or discharging from the contaminated soils area. Likewise, there is no evidence of surface flows running onto the Blue Rock or Scotchman piles except at the toe of those deposits. If any of the other alternatives are incorporated into this removal action it would be advisable not to create channels that will concentrate surface flows at any of these locations. Diverting the overland flow at any of these three locations will have no measurable affect on water quality in American Fork River or its tributaries and will further concentrate water on steep slopes leading to increased erosion. It would be advantageous to create barriers, such as riprap, at the toe of the waste deposits at Blue Rock and Scotchman to prevent the intermittent flows at Blue Rock and the river at Scotchman from coming into contact with those waste materials.

### 8.1.5 Alternative X - Excavation and Disposal in Permitted Off-Site Facility

*The discussion of this alternative is presented to provide the reader an explanation of why this alternative is not carried forward for consideration for implementation in the removal action. Most individuals who learn of the contaminated waste deposits in the North Fork of American Fork Canyon suggest that the most acceptable means of eliminating these potential sources of contamination is to remove them from the canyon and placing them in a hazardous waste land fill. Few people prefer that the contaminants be disposed of on-site until they become informed of the following information. The public generally recognizes the nearly impossible scenario that would allow the removal of the waste materials from the canyon as discussed below.*

This alternative would excavate contaminated materials from the waste rock piles and the mill site and place the material in a permitted off-site facility. The facility would be approved to dispose of this type of material and would provide long-term care and monitoring. This alternative would eliminate exposure of contaminated waste materials at the Site. This alternative would not reduce the toxicity nor volume of the contaminated materials but it would remove it from the canyon. The total estimated volume of material that would have to handled is 24,500 cy; or approximately 39,000 tons.

This alternative would be somewhat similar to Alternative 2 as it would require excavation, transportation, verification sampling, and possible regrading and revegetation of excavated areas.

The licensed disposal facility closest to the Site is 70 miles away in Tooele County, Utah. Unit prices quoted by the facilities operators for transportation and disposal fees would put the cost of this alternative at over $7,000,000. In addition the road that accesses the site would have to be reconstructed, at an estimated cost of $1,000,000, to accommodate the 2,450 end-dump truck loads needed to move this volume of waste.

Based on these unmanageable costs this alternative is not viable and will not be evaluated for consideration as an implementable alternative.

### 8.1.6 Alternatives Carried Forward for Evaluation and Potential Implementation

In summary of section 8.1 the following alternatives are considered worthy of consideration for implementation in formulating the proposed removal action at the mine sites in American Fork Canyon on private lands in the vicinity of Pacific Mine.

- Alternative 1 - Institutional Controls to Limit Access Including Fencing, Barriers, Signs, and Gates
- Alternative 2 - Excavation, Consolidation, and Disposal of Contaminated Materials in an On-Site Engineered Cell (Repository)
- Alternative 3 - Capping Contaminated Materials in Place
- Alternative 4 - Engineering Controls to Minimize Runon and Control Runoff of Surface Water At Waste Stockpiles

## 8.2 EFFECTIVENESS EVALUATION OF ALTERNATIVES

### 8.2.1 Effectiveness Criteria

The effectiveness of an alternative refers to its ability to meet the objectives within the scope of the removal action. There are several components of effectiveness as listed below.

Overall Protection of Public Health and Environment

Each alternative is evaluated as to how well it protects public health and the environment from potential impacts from the Site's contamination. This includes the local residents as well as worker health during the implementation of the removal action. This assessment is an overview of the other components of effectiveness.

Compliance with ARARs

Each alternative will be evaluated to determine if identified federal, state, and local ARARs are met by the removal action.

Long Term Effectiveness

The long-term effectiveness of the removal action includes the tendency for contaminants to leach from waste materials and the long-term effects from this leaching. Long-term effectiveness may also be affected by O&M requirements (covered in more detail in Section 8.3). The long-term effectiveness of the removal action is crucial, as the land owner would prefer not to implement another removal action involving these sites in the future.

Reduction of Toxicity, Mobility, or Volume Through Treatment

The EPA has a policy of preference for technologies that will permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances. Each alternative will therefore be evaluated to determine if the technology reduces the toxicity, mobility, or volume of the materials. Some technologies may by unacceptable because they increase the volume of the waste material; for instance, solidification requires the addition of materials that may increase the volume significantly.

Short Term Effectiveness

Short-term effectiveness addresses the effects of the alternative during implementation, before the removal objectives have been met. This may include such things as fugitive dust, hazardous waste transportation, interception and discharge of contaminated ground water during removal actions, etc., which affects the public, workers, and the environment during the implementation of the removal action.

### 8.2.2 Overall Protection of Public Health and Environment

The Site is relatively remote with no permanent inhabitants in the general vicinity and is likely to remain this way for the foreseeable future. Although a baseline risk assessment is not warranted for the Site, a general evaluation of risk to workers and the public during implementation of the alternatives is discussed in this section.

Alternative 1 would provide moderate protection to public health and little protection to the environment by limiting site access and thereby reducing the possibility of human exposure through direct contact, inhalation, and ingestion. Animal access, whether large or small, would not be restricted by barriers or signs. Although access to all of the management units would be restricted, the Pacific drainage could be diverted over time to come into contact with the mine waste rock pile and leach metals from those deposits. The mine drainage would continue to flow into and impact American Fork River. Also, the migration of waste rock due to water and wind would continue unabated, which would continue to impact the environment.

Alternatives 2 and 3 would provide a moderately high level of protection to public health and the environment by encapsulating the waste rock and mill deposits. These alternatives would greatly reduce the potential for exposure of contaminated materials to human population and to the environment. With Alternatives 2 and 3 there remain potential long-term impacts to the groundwater due to the generation of leachate. This leachate production would be minimized

by the installation of a substantial soil cover over the contaminated material. The contaminated material would remain on-site, so continuing protection would depend upon maintenance or replacement of the low permeability cover(s) as required over time.

Alternatives 2 and 3 would address the existing flow from the Pacific adit portal or the leachate produced from the waste deposits by eliminating the potential for the mine drainage from contacting the waste deposits. .

Alternative 4 would reduce the amount of moisture that flowed onto, across, and from the contaminated mine wastes. Protection to the environment from leachate would be improved and the waters in American Fork River would be in closer, if not in complete, compliance with Clean Water Standards throughout the river stretch impacted by these mine wastes. The greatest improvement would be realized by applying this alternative to the Pacific waste rock pile. Minimal improvement would result at Blue Rock, Pacific Mill, or Scotchman after applying the techniques of Alternative 4, and in fact may result in more sediment being transported to the river from these sites due to the concentration of overland flows on steep hillsides.

### 8.2.3 Compliance with ARARs

Alternative 1 would not achieve the ARARs provided in Section 3.1 because this alternative only limits site access and does not reduce the toxicity, mobility, or volume of the contaminated materials.

Alternatives 2 and 3 would comply with ARARs as they effectively remove and encapsulate contaminated materials that are above predetermined concentrations. Sampling would be performed to verify that remaining material that is exposed to the public/environment has concentrations below applicable ARARs. These alternatives are proven technologies and are generally readily implementable.

Alternative 4 would reduce the potential concentration of leachate from the mine wastes and be beneficial in attempts to meet the water quality standards provided in Section 3.1, specifically in the river sections downstream from Pacific and Sultana Smelter.

### 8.2.4 Long Term Effectiveness

Because Alternative 1 does not treat or control contaminated material; this alternative is not effective long-term for the purpose of providing protection to human and terrestrial receptors. With proper maintenance of the barricades and signs, the repository will have long-term protection from damage due to indiscriminate recreational vehicle use, particularly at the Pacific mine waste rock pile.

Alternatives 2 and 3 would be expected to be effective long-term as long as the integrity of the soil cover is retained. These alternatives would limit exposure of the contaminated materials to precipitation, minimize leaching, and effectively reduce migration of the contaminated materials. The covers proposed for Alternatives 2 and 3 would require periodic maintenance to remain effective.

Alternative 4 would be effective to an unknown degree in reducing the volume of leachate that is produced from the mine waste, although it would not be effective in reducing the toxicity or mobility of the mine drainage. This alternative would require some long-term maintenance such as grading and cleaning drainage features in order to continue to be effective.

### 8.2.5 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 1 would not provide a reduction in toxicity, mobility or volume.

Alternatives 2 and 3 would be effective in reducing the mobility of the contaminated materials. The material would be placed in an engineered cell, or capped in place, virtually eliminating the exposure of the contaminated materials to erosion from wind and surface water. Infiltration of water through the contaminated materials is also minimized. The toxicity and volume of the contaminated materials would not be affected by these alternatives.

Alternative 3 would be expected to be less effective than Alternative 2 in reducing the long-term mobility of the contaminated materials. This alternative would limit erosion and infiltration similar to Alternative 2 but may be more susceptible to erosion of their caps due to the location of the steep slopes where the materials were deposited. If the integrity of the caps were compromised due to erosion or sloughing, contaminated materials could be exposed to the environment.

Alternative 4 would be effective to an unknown degree at reducing the volume of the leachate from the waste deposits by reducing the volume of water that would runon and runoff the waste deposits. The mobilization of the waste deposits would be reduced with the reduction in surface erosion by overland flows.

### 8.2.6 Short Term Effectiveness

The implementation of Alternatives 1 would be effective in the short term because the implementation of the alternative would not pose significant risk to workers, the public, or the environment. Fewer of the public would enter the sites and come in contact with the contaminants. Minimal amounts of contaminated materials would be disturbed by the implementation of these alternatives.

Alternatives 2 and 3 would have low to moderate short term effectiveness. These alternatives probably have the highest chance of all the alternatives of impacting workers, the public, and the environment during their implementation; with 2 having the highest potential because it involves excavating, loading, hauling and placing the largest volume of waste. Most of these potential health impacts would be due to potential inhalation of fugitive dust and the ingestion of dust and contaminated materials (hand to mouth). Health and safety controls can be readily implemented to protect workers and the public. A Health and Safety Plan would be developed for the Site that addresses worker safety including dust control, monitoring, decontamination procedures, etc. Engineering controls such as the addition of water and magnesium-chloride to disturbed areas can be implemented to control dust. During the implementation of these alternatives there also would be the potential for short-term impacts to the environment due to spills, dust, and surface runoff from disturbed areas. These impacts can be readily controlled through appropriate transportation and engineering practices such as covering loads, cleaning up spills on-site, dust control measures, erosion protection, silt fences, etc.

## 8.3 IMPLEMENTABILITY EVALUATION OF ALTERNATIVES

The implementability criterion addresses the technical and administrative feasibility of implementing an alternative.

Technical Feasibility

Technical feasibility refers to the ability to construct, operate, maintain, replace, and monitor an alternative's technical components. Potential constraints associated with characteristics of the Site are also addressed. Due to the remote nature of the Site, some components of technical feasibility are of special importance and are addressed separately including; maintenance and monitoring requirements, construction feasibility, and availability of services and materials. Each alternative will be evaluated to determine of it can technically meet the Removal Action Objectives provided in Section 6.0, regardless of other factors such as regulatory restrictions, etc.

Maintenance and Monitoring Requirements

Each of the removal action alternatives should require minimal maintenance and monitoring. The Site's remote location and difficult access during winter and inclement weather conditions would make frequent and regular maintenance impractical. The feasibility of the removal action may be significantly affected by maintenance requirements; for example, a conventional wastewater treatment plant for the mine drainage would not be feasible at the Site because of the daily maintenance and monitoring requirements. It would be feasible however to schedule repairs, maintenance, and monitoring work during the summer months for passive remediation alternatives such as capping or institutional controls.

Construction Feasibility at the Site

Construction feasibility evaluates whether it is reasonably possible to construct the alternative at the Site. This includes site access issues, space available, utilities, and other factors that may affect construction feasibility.

Availability of Services and Materials

The availability of off-site treatment, storage, disposal capacity, equipment, personnel, services, materials, and any other resources necessary to implement an alternative will be evaluated. Because of the remoteness of the Site, the sensitivity of this evaluation criterion will be high.

Administrative Feasibility

Administrative feasibility includes required permits, regulatory acceptance of the alternative, and an evaluation of community acceptance. Each alternative will be evaluated to determine if the alternative requires permits, adheres to non-environmental regulations, and if it address concerns of other regulatory agencies. This may include NPDES discharge permits, easements,

etc. The acceptance of federal, state, and local regulatory agencies would be evaluated to determine if an alternative would be accepted by the responsible regulatory agencies.

Community Acceptance

Despite the remote character of the Site it can be accessed by the large population centers along the Wasatch Front including Provo, Salt Lake City, and their suburbs. Community acceptance of proposed alternatives is important and will be evaluated.

### 8.3.1 Technical Feasibility and Implementability

Alternative 1 is technically feasible as this alternative is easily constructed and maintained and the materials needed are readily available.

Alternatives 2 and 3 are technically feasible and have been implemented at similar sites. These alternatives can be executed using readily available machinery including; earthmoving equipment, haul trucks, and other conventional construction equipment. Maintenance requirements can be implemented during summer months. One component of the design of either alternative that would affect the technical feasibility would be a design that relied heavily on imported materials such as clay for use as impervious liners, rock for cover material, etc. The access road to the site is a single lane road in poor condition. It will require some improvement in order to allow heavy equipment to reach the site. Semi tractor with flatbed trailers cannot traverse this road. Repeated truck traffic would require major reconstruction of the access road. Some administrative closure of roads to public use within the Site may be required to provide protection of Forest users during hauling of materials from the various sites to the Pacific repository. The design of these alternatives should require the least number of trucks entering or leaving the site.

Alternative 4 can be implemented and maintained using readily available earthmoving and grading equipment.

### 8.3.2 Maintenance and Monitoring Requirements

Efforts were made to identify alternatives that were effective but did not require regular, frequent maintenance. Seasonal (e.g., summer time) maintenance and repairs were considered acceptable and feasible. All of the alternatives require annual monitoring and periodic maintenance.

Alternative 1 would require maintenance to inspect, repair, and possibly replace portions of the barriers, gates, and signs. This alternative is susceptible to vandalism and damage from snow accumulations, tree falls, and other natural occurrences. The maintenance would most likely be minor but would need to be performed on a regular basis indefinitely.

Alternative 2, 3 and 4 would also require inspection, maintenance, and repair as needed of the caps and drainage structures. The maintenance would require an annual site inspection followed by personnel, equipment and materials, as needed. Physical repairs may be required

to repair erosion damage, unacceptable settling or sloughing, or the need for additional vegetative cover and extermination of noxious weed infestations.

### 8.3.3 Construction Feasibility at the Site

All of the alternatives can be constructed at the Site. It will be necessary to perform heavy road maintenance above Holman Flat, through the hairpin switchbacks and the Narrows to accommodate use by heavy equipment and haul trucks. The contractor will be allowed to improve the road surface of the Forest Service Road to remove or cover the rock surface that has developed through years of surface loss (fines) in accordance with Forest Service standard maintenance procedures. Road improvements on private property will be needed to remove the waste materials from Blue Rock after which the road can be completely obliterated.

Implementing Alternative 4 at Pacific Mill would be difficult because of lack of access to the upper reaches of this site on a very steep hill side. Using this technique at both Pacific Mill and Blue Rock would probably result in excessive erosion of the steep hillsides at the outlet of the diversion ditches. The steep hill sides coupled with concentration of surface flow in interceptor ditches would lead to high flow velocities accelerating erosion development and the potential for higher levels of maintenance at shorter intervals.

### 8.3.4 Availability of Goods and Services

It appears that most of the required goods and services for the alternatives are reasonably available. It is anticipated that the contractors, labor, equipment, and most of the materials could come from the cities located within 50 miles of the Site. Due to access limitations for hauling vehicles alternatives that minimize the need to import large volumes of materials should be considered preferable.

### 8.3.5 Administrative Feasibility

Because the EPA has a preference for technologies that will permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances, Alternative 1, institutional controls, may not constitute a long term removal action if implemented as a sole action, though fencing, signs, and debris removal may be incorporated in conjunction with other alternatives. Limiting site access may also be an issue with the many ATV users and user groups that frequent American Fork Canyon and have used the waste rock piles and mill site as recreational sites. Unlike the previous removal action on NFS lands implemented in 2003 by the Forest Service, this proposed action will occur on private property where the land owner controls and determines the type and extent of public use. Concerns of various Forest user groups are less important when considering actions on private property when compared to those on public lands. Under Alternative 2 and 3 the Pacific waste rock pile location would be configured in such a way that ATV users would again concentrate their use at this location which would be detrimental to the success of the removal actions and therefore would be unacceptable. Use of barriers and signs would be instrumental features in achieving a long term treatment of the potentially hazardous substances at this site.

Alternatives 2 and 3 appear to be administratively feasible because they treat the contaminated material, are proven methods, reduce the land owner's liability associated with potential releases of hazardous materials from private land to public land, require no additional permits other than an Administrative Order on Consent issued by EPA, and are compatible with the land owners objectives and Federal policy.

Alternative 4, control runon and runoff, may not be acceptable as a stand alone alternative because it does not reduce the toxicity, mobility, or volume of the hazardous substances permanently. This technology will be needed to make Alternatives 2 and 3, fully affective.

The land owner has demonstrated a long-term commitment to superb land stewardship at the developed sites in Little Cottonwood and recently in Mineral Basin. The immediate management objective for the Site is to retain its relative remoteness and wild nature while removing the potential impacts to the environment, humans, and wildlife characteristic of these mine wastes. In the long term, the treated site(s) containing contaminated materials will be maintained for that purpose and eliminated from future development while the adjacent private property will have added value for a variety of future uses.

Removal actions would be conducted in coordination with the appropriate authorities. The proponent will communicate with the public, the media, the EPA, and state and local officials as required and as stated in the Community Relations Plan dated March 28, 2000 developed by the Forest Service specifically for actions at this Site.

### 8.3.6 Community Acceptance

Alternatives 1, 2, and 3 would eliminate or restrict public access to areas presently being used for recreational destinations by some individuals and organizations. Exploring historic ruins draws people of all ages looking for hidden "treasures" like a mini rail spike, square nail, or clump of iron pyrite. Others have used sites like the Pacific waste piles as motocross sites where they could ride ATVs and motorcycles up steep slopes or get airborne of humps and hills of waste rock. These users may be opposed to closure of these areas to public use. But it is important to again note that these sites are on private land which is under the control of the land owner. Public use of those lands is strictly subject to the land owner's discretion.

Some prior public uses, such as ATV riding on waste rock piles, have recently become unacceptable because of the adverse impact the use is having on the environment as well as the potential health hazards they present to the users. Canyon users have, for the most part, accepted the restrictions imposed on the mine sites by the Forest Service because of the explanatory signs that were placed at the sites letting the public understand the reason those sites had been closed and the impact the contaminants could have on the environment and the people using the sites. The land owner is still allowing use of private lands by the general public for recreational purposes but that is subject to change without prior notice. The more abusive the nature of the public use becomes, the sooner additional restrictions will be imposed. Implementing these alternatives will assist the land owner and Forest Service personnel in enforcing allowable use practices by eliminating access to areas not conducive to public use. There are numerous users and organized groups that support environmentally sensitive public

use in American Fork Canyon regardless of land ownership as evidenced by public scoping efforts conducted by the Forest Service in preparation for their 2003 Removal Action.

It is anticipated that the majority of the local community would support implementation of any of the alternatives being considered for this removal action. Due to the remote location of the Site there is not expected to be significant issues with noise or dust during construction. Some individuals may be displaced during construction as roads are closed to public use. The on-the-ground construction activity should be 30 days or less minimizing impacts due to the project.

## 8.4 COST EVALUATION OF ALTERNATIVES

### 8.4.1 Cost Criteria

Site specific data and surveys have been collected at Pacific Mine, Pacific Mill, Blue Rock, and Scotchman No. 2. Most of the quantities shown in this section are based on information that will be used for final design of the removal action and should be reflective of actual pay quantities as the work of the removal action is concluded.

Subsoil sampling has been performed at Pacific Mine. Those samples indicated that it may be necessary to excavate below the waste rock piles to reach metal levels that are below the maximum metal concentrations (PRG) for materials to be left in place. The metal contents will be monitored using a field X-ray Florescence Spectrometer during excavation to determine when this allowable maximum metal concentration is reached. The metal that will be considered indicative of soils presenting minimal risk to humans or the environment is lead (Pb). Based on reports prepared for EPA for American Fork Canyon, the cutoff lead concentration will be 2160 ppm. All mine wastes will be removed down to in-situ soils and excavation will continue into those soils until the soil contains less than 2160 ppm lead. At that point the other metals present in the soils will be reviewed to ensure that no additional removal is needed.

Estimated costs of the alternatives include indirect capital costs, direct capital costs, and annual costs. Estimated costs were prepared utilizing estimated volumes, vendor quotes, available literature, Means Cost Data guides (Means, 1997), Forest Service Cost Estimating Guide for Roads Construction, the unit prices from the 2003 Forest Service Removal Action Contract, and other sources deemed appropriate.

<u>Indirect Capital Costs</u>

These costs include indirect expenses that are necessary to complete the alternative. Most of these costs are incurred prior to the actual implementation of the alternative. These costs include; engineering, permits, Hazwopper training for work force, and oversight costs – including EPA's oversight costs. This is necessary because EPA's budget constraints do not provide funding for participation in projects that are Non Time Critical in nature as is this project. So to allow EPA to be involved there needs to be a funding mechanism established to cover those costs. For this project the proponent will provide those funds to EPA for their On-Scene Coordinators commitment.

Direct Capital Costs

These costs include costs to directly implement the alternative such as; construction costs, materials, services, and disposal costs.

Annual Costs

After the alternative is implemented, it may be necessary to perform periodic inspection, operation, maintenance, and repairs. These costs are estimated on an annual basis in 2004 dollars.

Present Worth Cost

Present worth costs represent the amount of money in current dollars (2004) needed to cover all of the expenditures associated with a removal alternative. They enable the comparison of costs in an equal basis for expenditures that occur over different time periods. A discount (interest) rate of 5 percent has been used to calculate present worth costs. This is approximately the present cost of money to the U.S. Government. The estimated length of annual O&M costs is projected into the foreseeable future since the contaminants of concern, e.g. metals, do not degrade over time. As an example calculation, if the capital cost of an alternative is $200,000 and the annual O&M cost is $9,000, both expressed as 2004 dollars, then the present worth cost is $200,000 plus $9,000 divided by 0.05, which equals $380,000. You would pay $200,000 immediately for construction, and invest an additional $180,000 at 5 percent interest to obtain the annual O&M costs of $9,000 in perpetuity.

### 8.4.2 Conceptual Cost Estimates

Detailed cost tables for the alternatives are included in Appendix D, Removal Action Alternatives Cost Estimates. Table 8-3 summarizes the estimated costs for the alternatives.

**TABLE 8-3 COSTS OF ALTERNATIVES**

| ALTERNATIVE | INDIRECT CAPITAL COST ($) | DIRECT CAPITAL COST ($) | TOTAL CAPITAL COST ($) | ANNUAL O&M COST ($)* | PRESENT WORTH COST ($) | DETAILED COST TABLE REFERENCE ** |
|---|---|---|---|---|---|---|
| 1- Institutional Controls | $5,000 | $18,000 | $23,000 | $1,000 | $43,000 | Alt 1, Appx 4 |
| 2- Excavation, Consolidation, Disposal in On-Site Cell | $20,000 | $138,500 | $158,500 | $1,000 | $178,500 | Alt 2, Appx 4 |
| 3- Capping Materials in Place | $20,000 | $110,000 | $130,000 | $2,000 | $170,000 | Alt 3, Appx 4 |
| 4- Control Runon and Runoff at Waste Deposits | $5,000 | $19,000 | $24,000 | $2,000 | $100,000 | Alt 4, Appx 4 |

* Present worth cost based on 5% discount (interest) rate and an O&M period running through the foreseeable future

** See Appendix D

Alternative 1 - Institutional Controls to Limit Access Including Fencing, Signs, and Gates

The present worth cost for Alternative 1 is estimated at approximately $43,000. This estimate includes indirect and direct costs totaling $23,000 and an annual cost for inspection and maintenance of $1,000. The majority of cost is for barrier materials and labor required to install a W-beam guardrail and 2 gates on the roads leading to Blue Rock. The minimal annual cost for this alternative is designated for inspection of the barrier, gates, and signs and the materials and labor used for repairs. Additional details regarding the cost estimate are provided in Appendix D, Alternative 1 – Institutional Controls To Limit Access.

Alternatives 2 and 3 – Waste Containment Alternatives

As seen in Table 8-3, Alternatives 2 and 3 are competitive with each other and have similar estimated costs. Both alternatives would cover contaminated solid material, (waste rock and contaminated soils) with a low permeability cap(s).

In Alternative 2 the contaminated solid material from the waste rock piles and mill site would be excavated, consolidated, and placed in an excavated cell in a "high and dry" on-site location at the present Pacific waste rock pile. The existing waste rock pile at Pacific would be reshaped in a way that would provide sufficient width for the Miller Hill Access Road to be relocated to an alignment along the toe of the reshaped pile. The materials from the other 3 Management Units would be excavated and hauled to the repository. The repository would be covered with an impervious composite geotextile liner and a three foot thick layer of soil.

*(The proponent's preferred capping technique for this alternative would not utilize the composite geotextile materials but would simply cover the spoils with three feet of uncontaminated soils followed by revegetative applications. Eliminating the liner would reduce the present worth cost of this alternative to about $102,000. The liner will be installed if the regulatory agencies determine it is essential to the success of this removal action. With the concurrence of the regulatory agencies the liner will be eliminated.)*

This alternative includes reclaiming all the disturbed sites by seeding, mulching, and fertilizing all disturbed sites and installing erosion control blankets on the steeper sites. The road to the Blue Rock waste rock pile would be reconditioned to allow use by heavy equipment and obliterated upon completion of work at that site. The cost estimate shown here for Alternative 2 includes all that work and more (including road repairs to access the Site, erosion control measures, environmental protection to prevent water pollution, etc.)

Alternative 2 has an estimated total capital cost of $178,500. The annual O&M costs for this site is $1000 which provides for an annual inspection and minor repairs and maintenance as needed. Maintenance costs should be minimal unless the sites are vandalized (an example would be someone violating the closure restrictions and operating their recreational vehicle on the repository before the vegetation gets well established which would require raking our the

tracks and reseeding the disturbed portion of the site). The present worth cost of Alternative 2 is estimated at $138,500, which is about 26% more than the estimated cost of Alternative 3.

Alternative 3, Capping Contaminated Wastes In Place, has an estimated capital cost of $110,000. There would be minimal cost for excavation and transport of cover material to cap the Pacific waste rock pile but the other three sites would be capped using a gunnite or shot-crete material which would have high supply and application costs. These costs include installing a liner over the spoils materials at Pacific at a cost of about $50,000 before the soil cap is placed. *(As in Alternative 2, the liner could be eliminated if that were allowed by the regulatory agencies.)*

The annual maintenance costs will be higher for Alternative 3 because the four separate caps have greater surface area to maintain and the locations for Blue Rock, Scotchman, and Pacific Mill are subject to increased erosion rates because they are on steep side hills not well suited for capping. Each of these locations will require much care to protect and maintain the caps. With the higher estimated annual O&M cost, Alternative 3 has an estimated present worth cost of $170,000, which for practical comparisons is the same as Alternative 2. Although this alternative has a similar cost to the other containment alternative, it carries a higher risk of failure due to the nature of the capping technique proposed on the steep slopes of Pacific Mill, Blue Rock, and Scotchman.

Alternatives 4 – Control Runon and Runoff at Waste Deposits

Alternative 4 has a low capital investment of $19,000 but it is directed at a small portion of the problem at the mine locations in American Fork Canyon, the leaching of contaminants from the wastes into the surrounding environment and American Fork River. These drainage structures would require annual maintenance to keep them functional overtime. The annual O&M costs of maintaining the ditches is estimated at $2,000 because much of that work will have to be done by manual labor to avoid unwarranted disturbance to the adjacent contaminated materials.

Summary Statement of Alternative Cost Evaluations

In summary, based on cost alone Alternative 3 is cheaper than Alternative 2 (these two alternatives both encapsulate the waste materials and achieve the highest level of protection to human health and welfare and to the environment). Alternative 2 has a significantly higher level of long term success and is considered a better option than Alternative 3. The costs for Alternative 1 and 4 are much less than either Alternative 2 or 3 but they are basically short-term applications when considered as stand alone alternatives and may require additional future removal actions to be taken to eliminate the potential for a release of contaminated materials from private land onto public lands. Although neither of these alternatives meet the objectives of the proposed removal action, they both contain remedial techniques needed to supplement the procedures outlined in either Alternative 2 or 3 to ensure the highest confidence in the success of the removal action selected for this project.

## 8.5 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

In this section, the four alternatives for the American Fork Canyon Site are compared on the basis of effectiveness, implementability, and cost. This comparison considers how well the alternative meets the encompassing objectives of the removal action. The comparison is displayed in Table 8-4 and is discussed below.

**TABLE 8-4 COMPARATIVE ANALYSIS OF ALTERNATIVES**

| ALTERNATIVE | Effectiveness | Implementation | Cost |
|---|---|---|---|
| 1- Institutional Controls | Low | High | Low |
| 2- Excavation, Consolidation, Disposal in On-Site Cell | High | Average | High |
| 3- Capping Materials in Place | Average | Low | High |
| 4- Control Runon and Runoff at Waste Deposits | Low | High | Low |

Alternative 1 limits access to contaminated materials by the responsible public but does not treat any of the contaminated materials. This alternative is easy to implement and has a low cost but does not limit the migration of contaminated solid materials into the environment and flow of mine drainage into American Fork River. Certain undisciplined individuals will continue to enter the site and be exposed to the contaminated materials. Wildlife would still be subjective to exposure to the contaminated materials.

Alternative 2 is a proven technology and would be effective in minimizing exposure of the solid contaminated waste materials long-term. The cost is high but it is considered cost effective because it achieves most of the removal objectives for this project. Utilizing the Pacific Mine site as the location for the repository, this alternative can be implemented without encountering major obstacles.

Alternative 3 incorporates capping techniques that will cover the contaminated materials and prevent future releases from occurring at these sites. However the anticipated operational life of the caps at Blue Rock, Scotchman and Pacific Mill is considerably shorter, perhaps as little as 1/2 or 1/3 that of the soil cap at Pacific Mine. The Blue Rock and Scotchman both have the toe of their piles in streambeds where they could potentially be adversely impacted by floodwaters, thereby significantly increasing potential maintenance costs for the caps.

Alternative 4 is technically effective in reducing leaching and erosion of contaminants from the waste deposits in the environment but it does not reduce the toxicity, quantity or exposure of the contaminated deposits. Due to the physical location of the deposits this alternative will be more effective at some mines than at others and would not be usable at Pacific Mill. The ease of implementing the alternative is more difficult at some locations. The cost for this alternative is low.

All the alternatives would be implemented according to regulatory requirements and good engineering practices. The potential short-term impacts to human health and the environment resulting from some of the alternatives would be minimized by engineering controls and appropriate health and safety requirements.

In summary, each of the 4 alternatives provides viable applications for a removal action in American Fork Canyon. Alternative 3 is the less expensive "containment" alternative but Alternative 2 is more environmentally acceptable. Alternative 1 would have to be employed, at least in part, with either Alternative 2 or 3 to prevent significant damage to the caps from indiscriminant recreational vehicle use. Alternative 4 provides a means for reducing erosion from overland flow and precipitation accumulations at the repository that would be constructed under Alternative 2. The basis of Alternative 3 would be incorporated into the design of a repository at Pacific Mine to contain the wastes already in place at that site.

### 8.5.1 Proposed Combined Alternative

The result of this report is that the optimal removal action at the American Fork Canyon site should incorporate portions of all four of the alternatives evaluated above. This combined alternative, or the Proposed Combined Alternative, adopts Alternative 2 and adds essential components from the other alternatives to develop a comprehensive removal action that best meets the objectives of this action and provides the longest lasting, most effective treatment to minimize future problems associated with the contaminated materials from the four management units. The Proposed Combined Alternative results in a repository being constructed at the Pacific Mine site, capping in place the Pacific Mine waste rock pile after he wastes from the other sites are consolidated at this location. The repository would have barriers installed around the lower perimeter to prevent ATV's from entering the site and signs at each of the sites explaining the restoration actions and the reasons the areas are closed to public use. Drainage features to reduce the potential for leaching of contaminants from the buried wastes or erosion of the cap containing those wastes would be constructed. The direct capital investment of this combined alternative with a liner separating the contaminated wastes from the soil cap is $153,600. This is an increase of about $15,000 over the cost of Alternative 2. These costs are itemized in Appendix 4 in Alternative 5 - Proposed Combined Alternative. Without the liner the cost of that alternative is only $96,000. The Present Worth Cost of the proposed alternative is $193,600 with the liner and $136,000 without the liner.

The proponent of this Removal Action will continue discussions and negotiations with the State and Federal regulatory agencies to gain authorization for implementation of this action. The final decision determining which components of each of the alternatives will be incorporated in the project will be a product of agreements made between the proponent and the agencies.

## 9.0 BIBLIOGRAPHY


National Aquatic Monitoring Center (November 26, 2001) ***Aquatic Invertebrate Monitoring Report,*** Mark Vinson, Ph.D.

TechLaw Inc. (June 15, 2001) ***Supplemental Potentially Responsible Party Search Final Draft Report to the American Fork Canyon Mine Site, Dutchman Flat Mine Site,*** Enforcement Confidential

Science Applications International Corporation (May 11, 2001) ***Watershed Restoration Evaluation, American Fork Canyon, Uinta National Forest, Utah,*** Gerald Zimpher, Ph.D., Project Manager

Tetra Tech EM Inc. (March 21, 2001) ***Imminent and Substantial Endangerment to Human Health and Environment Due to Metals Contamination at American Fork Canyon Sites, Uinta National Forest, Utah County, Utah,*** Paul Damian PhD, MPH, DABT *(Preliminary Remediation Goal Recommendations)*

USDA, Forest Service (2000) ***Cost Estimating Guide for Road Construction***

U.S. Department of Interior (November 2000) ***A Preliminary Investigation Report, American Fork Canyon Watershed Reclamation Project,*** USBR Provo Area Office

Uinta National Forest (June 8, 2000) ***Pacific Mine tailings Closure Administrative Record,*** Ted V. Fitzgerald, On-Scene Coordinator

TechLaw Inc. (January 20, 2000) ***Potentially Responsible Party Search Draft Report, American Fork Canyon Mine Site,*** Enforcement Confidential

U.S. Department of Agriculture (1999) ***Aerial Photography 1:9600,*** Aerial Photography Field Office

U.S. Geological Survey (October 1999) ***Quantification of Metal Loading by Tracer-Injection and Synoptic Sampling, American Fork Watershed, Utah,*** Briant A Kimball, Robert L. Runkel, and Linda J. Gerner

U.S. Department of Agriculture (July 7, 1999) ***Engineering Evaluation/Cost Analysis For Missouri Mine,*** James Curtis, Boise National Forest On-Scene Coordinator

Utah State University (1998) ***An Investigation of Plant Specific Native to the Intermountain West for Use in the Phytoremediation of Lead in Contaminated Soils,*** Stephen Klassen, MS Thesis

U.S. Department of Interior (December 1996) ***Risk Management Criteria for Metals at BLM Mining Sites***. Technical Note 390 Revised October 5, 1998

U. S. Department of Agriculture (August 1996) ***Forest Service Specifications for Construction of Roads and Bridges***

Uinta National Forest (June 8, 1994) ***Heritage Resource Inventory of American Fork Area Mine Closures, Utah County, Utah, Final Report,*** Richard I. Crosland and Charmaine Thompson, Forest Archaeologist

Uinta National Forest (1994) ***Preliminary Assessment, Pacific Mine, Lower Bog Mine, and Mary Ellen Gulch Mine,*** Dave Stricklan, Resource Specialist and Robert Easton, District Ranger

Lidstone and Anderson, Inc. (February 3, 1993) ***American Fork Hydrology an Water Quality Study***

University of Wyoming (May 1992) ***Year End Report On Mitigation Systems For Hard Rock Mine Effluent In Utah,*** Nancy Culp, Et Al

Uinta National Forest (July 1988) ***Preliminary Survey of Water Quality in Mine Drainage in the Sheeprock Mountains and North Fork of the American Fork River,*** Lavere B. Merritt, Ph.D. Environmental Engineer

USDA Intermountain Region (1988) ***Aquatic Ecosystem Inventory, Macroinvertebrate Analysis, North Fork American Fork River and Mary Ellen Gulch Creek, Uinta National Forest,*** Fred A. Mangum, Regional Aquatic Ecologist

US Fish and Wildlife Service (1987-93) ***Metal Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review*** Ronald Eisler *(Several Biological Reports Containing Human Consumption of Contaminated Fish Recommendations)*

USDA, Forest Service Intermountain Region (July 1985) ***Reclamation Recommendations for Pacific Mine, Pleasant Grove Ranger District, Uinta National Forest,*** Ben Albrechtsen, Region 4 Reclamation Specialist.

USDA, Forest Service Intermountain Region (March 2002) ***Engineering Evaluation and Cost Analysis for American Fork Canyon Mine Reclamation Project,, Pleasant Grove Ranger District, Uinta National Forest,*** Ted V. Fitzgerald, AFC On-Scene Coordinator, and Others.

# APPENDIX A

## Water Monitoring Tables

2000 Water Monitoring in AFC Dissolved Metals
2000 Water Monitoring in AFC Total Metals
American Fork AML Water Quality Monitoring 2004

Source:

Uinta National Forest
Water Quality Sampling Reports
2000 and 2004

| 2000 WATER MONITORING IN AFC DISSOLVED METALS | Date | D_As | D_Cd | D_Cu | D_Hg | D_Pb | D_Zn | D_Al | D_Cr | D_Fe | D_Mg | D_K | D_Ag | D_Ba | D_Ca | D_Mn | D Na | D_Se | Flow | T. Hardns. | Field pH | Lab pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site Name | MMDDYY | ug/l | ug/l | ug/l | ug/l | ug/l | ug/l | ug/l | ug/l | ug/l | mg/l | mg/l | ug/l | ug/l | mg/l | ug/l | mg/l | ug/l | cfs | mg/l | | |
| AF-5 NFAF ab Pacific Mine | 06/06/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | 55 | <5.0 | 76.8 | 8.47 | <1 | <2.0 | 57.2 | 21.3 | 6.1 | <1.0 | <1.0 | 28.1 | 88 | 7.9 | 8.02 |
| AF-5 NFAF ab Pacific Mine | 07/19/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | <30.0 | <5.0 | 40.2 | 13.1 | <1 | <2.0 | 57.4 | 29.9 | 7.6 | <1.0 | <1.0 | 2.1 | 128.5 | 8.1 | 8.26 |
| AF-5 NFAF ab Pacific Mine | 08/23/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | 43.5 | <5.0 | 103 | 11.1 | <1 | <2.0 | 58.5 | 26.7 | 7.9 | 1.39 | <1.0 | | 112.3 | 7.9 | 8.12 |
| AF-5 NFAF ab Pacific Mine | 09/25/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | 37.1 | 58.3 | <5.0 | 307 | 10.9 | | <2.0 | 58.4 | 26.6 | 16.1 | | <1.0 | | 111.2 | 7.86 | 8.13 |
| AF-6 Pacific Mine Adit | 06/01/00 | <5.0 | 8.9 | <12.0 | <0.2 | <3.0 | 1300 | <30.0 | <5.0 | 112 | 24.9 | <1 | <2.0 | 82.8 | 45.1 | 10.2 | 1.77 | 1.1 | 0.9 | 215 | 8 | 7.74 |
| AF-6 Pacific Mine Adit | 07/24/00 | <5.0 | 12.2 | <12.0 | <0.2 | <3.0 | 1430 | <30.0 | <5.0 | 120 | 23.2 | <1 | <2.0 | 97.5 | 41.7 | 15.6 | 1.26 | <1.0 | 1.4 | 199.5 | 7.2 | 7.23 |
| AF-6 Pacific Mine Adit | 08/22/00 | <5.0 | 10.1 | <12.0 | <0.2 | <3.0 | 1450 | <30.0 | <5.0 | 22.9 | 23 | <1 | <2.0 | 93.3 | 45.4 | 8.6 | 1.72 | <1.0 | | 207.9 | 7.2 | 7.44 |
| AF-6 Pacific Mine Adit | 09/20/00 | <5.0 | 7.7 | <12.0 | <0.2 | <3.0 | 1190 | <30.0 | <5.0 | <20.0 | 23.5 | | <2.0 | 85.6 | 42.3 | 7.4 | | <1.0 | | 202.2 | 6.52 | 7.56 |
| AF-7 Spring Near Pacific Mine | 06/07/00 | <5.0 | <1.0 | <12.0 | <0.2 | 4.7 | 94 | <30.0 | <5.0 | <20.0 | 29.2 | <1 | <2.0 | 136 | 36.5 | <5.0 | 1.56 | <1.0 | 0.1 | 211.2 | 7.4 | 7.49 |
| AF-8 Pacific Mine Beaver Pond Outlet to NFAF | 06/07/00 | <5.0 | 4.1 | <12.0 | <0.2 | <3.0 | 557 | <30.0 | <5.0 | 26.4 | 28.2 | <1.0 | <2.0 | 106 | 54.5 | 29.1 | 1.62 | <1.0 | 0.1 | 252 | 7.7 | 7.93 |
| AF-8 Pacific Mine Beaver Pond Outlet to NFAF | 09/27/00 | <5.0 | 4.2 | <12.0 | <0.2 | <3.0 | 571 | <30.0 | <5.0 | <20.0 | 23.2 | <1 | <2.0 | 87.8 | 39.9 | 51.3 | 1.79 | <1.0 | | 195 | 7.58 | 7.96 |
| AF-9A Pacific Mine Upper Tailings Discharge | 06/07/00 | <5.0 | 7.7 | <12.0 | <0.2 | 23.3 | 836 | <30.0 | <5.0 | 36.1 | 26.3 | <1 | <2.0 | 123 | 49.4 | 36.1 | 1.48 | 1.3 | 0.03 | 231.5 | 7.7 | 8.09 |
| AF-9A Pacific Mine Upper Tailings Discharge | 09/20/00 | <5.0 | 3.5 | <12.0 | <0.2 | 3.6 | 377 | <30.0 | <5.0 | <20.0 | 23.3 | | <2.0 | 107 | 42.4 | 64.2 | | <1.0 | | 201.7 | 7.62 | 8.34 |
| AF-9B Discharge from Tailings, Middle | 06/07/00 | <5.0 | 8.8 | <12.0 | <0.2 | 10.9 | 927 | <30.0 | <5.0 | <20.0 | 26.3 | <1 | <2.0 | 110 | 48.3 | 6 | 1.53 | 1.4 | 0.3 | 228.7 | 7.8 | 8.22 |
| AF-9C Pacific Mine Discharge from Lower Tailings | 06/07/00 | <5.0 | 27.1 | <12.0 | <0.2 | 130 | 2520 | <30.0 | <5.0 | <20.0 | 25.3 | <1 | <2.0 | 134 | 48.6 | 8.6 | 1.54 | 8.6 | 0.01 | 225.4 | 7.6 | 8.07 |
| AF-10 NFAF bl Pacific Mine | 06/06/00 | <5.0 | <1.0 | <12.0 | 0.219 | 4.1 | 44.8 | 55.3 | <5.0 | 143 | 9.2 | <1 | <2.0 | 45.4 | 22.3 | 6.7 | <1.0 | <1.0 | 35 | 93.5 | 7.6 | 8.15 |
| AF-10 NFAF bl Pacific Mine | 07/19/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | 80.1 | <30.0 | <5.0 | 65.4 | 15 | <1 | <2.0 | 59.5 | 31.5 | 11.5 | <1.0 | <1.0 | 5 | 140.3 | 8.2 | 8.37 |
| AF-10 NFAF bl Pacific Mine | 08/23/00 | <5.0 | <1.0 | <12.0 | <0.2 | 12.3 | 70.1 | <30.0 | <5.0 | 67.3 | 16.2 | <1 | <2.0 | 62.6 | 33.1 | 21.1 | 1.59 | <1.0 | | 149.2 | 7.8 | 8.19 |
| AF-10 NFAF bl Pacific Mine | 09/25/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | 49.4 | <30.0 | <5.0 | 122 | 15.8 | | <2.0 | 54.2 | 33.1 | 20 | | <1.0 | | 147.6 | 7.94 | 8.38 |
| AF-11 NFAF @ Dutchman Flat ab Mary Ellen | 06/07/00 | <5.0 | <1.0 | <12.0 | <0.2 | 4.8 | 47 | 44.7 | <5.0 | 72.8 | 11.9 | <1 | <2.0 | 59.5 | 27.9 | 5.3 | <1.0 | <1.0 | 35.5 | 118.6 | 8 | 8.26 |
| AF-11 NFAF @ Dutchman Flat ab Mary Ellen | 07/19/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | 47.8 | <30.0 | <5.0 | 28.4 | 17.1 | <1 | <2.0 | 61.7 | 35.2 | 6.2 | 1.04 | <1.0 | 6.5 | 158.2 | 8.2 | 8.45 |
| AF-11 NFAF @ Dutchman Flat ab Mary Ellen | 08/22/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | 33.7 | <30.0 | <5.0 | 20.8 | 17.2 | <1 | <2.0 | 65.8 | 36.6 | 6.2 | 1.58 | <1.0 | | 162.1 | 8.4 | 8.44 |
| AF-11 NFAF @ Dutchman Flat ab Mary Ellen | 09/25/00 | <5.0 | <1.0 | <12.0 | <0.2 | 4.2 | 36.2 | <30.0 | <5.0 | 37.6 | 18 | | <2.0 | 65.6 | 37.3 | 6.9 | | <1.0 | | 167.1 | 8.05 | 8.46 |
| AF-11A NFAF bl Shaffer, ab Mary Ellen | 06/08/00 | <5.0 | <1.0 | <12.0 | <0.2 | 5 | 56.1 | | <5.0 | 64.6 | 11.7 | <1 | <2.0 | 50.2 | 27 | 6.9 | <1.0 | <1.0 | 37.1 | 115.5 | 8.2 | 8.21 |
| AF-12 NFAF bl Mary Ellen | 06/07/00 | <5.0 | <1.0 | <12.0 | <0.2 | 3.4 | 56.8 | 35.3 | <5.0 | 41.9 | 11.7 | <1 | <2.0 | 51.9 | 28 | 5.7 | <1.0 | <1.0 | 44.4 | 118 | 8.26 | 8.19 |
| AF-12 NFAF bl Mary Ellen | 07/19/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | 47.2 | <30.0 | <5.0 | 20.8 | 16.3 | <1 | <2.0 | 62.4 | 35 | 8.4 | <1.0 | <1.0 | 7.6 | 154.4 | 8.2 | 8.44 |
| AF-12 NFAF bl Mary Ellen | 08/22/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | 35.6 | <30.0 | <5.0 | 27.3 | 17 | <1 | <2.0 | 65.7 | 38.1 | 11.9 | 1.71 | <1.0 | | 165 | 9 | 8.47 |
| AF-12 NFAF bl Mary Ellen | 09/26/00 | <5.0 | <1.0 | <12.0 | <0.2 | 3.1 | 40.1 | <30.0 | <5.0 | 39.5 | 17.2 | <1 | <2.0 | 60 | 35.4 | 13.9 | 1.87 | <1.0 | | 159.1 | 8.03 | 8.39 |
| AF-13 NFAF ab Major Evans | 06/08/00 | <5.0 | <1.0 | <12.0 | <0.2 | 3.5 | 51.3 | 37.2 | <5.0 | 52.4 | 11.9 | <1 | <2.0 | 56.8 | 28.6 | <5.0 | <1.0 | <1.0 | 41.6 | 120.3 | 8.05 | 8.31 |
| AF-13 NFAF ab Major Evans | 09/19/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | <30.0 | <5.0 | 23.1 | 18.1 | | <2.0 | 64.7 | 39.3 | <5.0 | | <1.0 | | 172.5 | 7.95 | 8.59 |
| AF-14 Major Evans @ Mouth ab NF | 06/08/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | 31.4 | <5.0 | <20.0 | 19.1 | <1 | <2.0 | 53.2 | 44.3 | <5.0 | <1.0 | <1.0 | 7.4 | 189.1 | 8.1 | 8.61 |
| AF-14 Major Evans @ Mouth ab NF | 09/19/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | <30.0 | <5.0 | <20.0 | 19.7 | | <2.0 | 56.5 | 40.1 | <5.0 | | <1.0 | | 181.1 | 7.98 | 8.66 |
| AF-15 NFAF bl Major Evans | 06/08/00 | <5.0 | <1.0 | <12.0 | <0.2 | 3 | 45.1 | 33.7 | <5.0 | 48.9 | 12.4 | <1 | <2.0 | 56.2 | 30.1 | <5.0 | <1.0 | <1.0 | 42 | 126.1 | 7.9 | 8.37 |
| AF-15 NFAF bl Major Evans | 09/19/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | <30.0 | <5.0 | 21.2 | 17.9 | | <2.0 | 64.6 | 38.8 | <5.0 | | <1.0 | | 170.5 | 7.96 | 8.55 |
| AF-16 NFAF ab Silver Creek Confluence | 06/08/00 | <5.0 | <1.0 | <12.0 | <0.2 | 3.6 | 42 | 36 | <5.0 | 35.1 | 12.7 | <1 | <2.0 | 51.9 | 31.4 | <5.0 | <1.0 | <1.0 | 48.5 | 130.6 | 7.98 | 8.32 |
| AF-16 NFAF ab Silver Creek Confluence | 09/27/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | 37.2 | <30.0 | <5.0 | <20.0 | 18.5 | <1 | <2.0 | 62.8 | 41.1 | <5.0 | 1.56 | <1.0 | | 178.7 | 8.05 | 8.4 |
| AF-17 NFAF bl Silver Creek | 06/15/00 | | | | <0.2 | | | <30.0 | | | 11.4 | <1 | | | 30.7 | | 1.54 | | 44.6 | 123.5 | 8.3 | 8.45 |
| AF-17 NFAF bl Silver Creek | 07/18/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | 33.3 | <30.0 | 8.1 | <20.0 | 17.7 | <1 | <2.0 | 69.6 | 43.2 | <5.0 | 1.34 | <1.0 | 10.5 | 180.6 | 8.4 | 8.55 |
| AF-17 NFAF bl Silver Creek | 08/22/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | <30.0 | <5.0 | <20.0 | 18.3 | <1 | <2.0 | 62.2 | 44.7 | <5.0 | 1.7 | <1.0 | | 186.8 | 8.4 | 8.39 |
| AF-17 NFAF bl Silver Creek | 09/26/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | 35.1 | <30.0 | <5.0 | <20.0 | 18.2 | <1 | <2.0 | 63.1 | 42.3 | <5.0 | 1.62 | <1.0 | | 180.4 | 8.22 | 8.46 |
| AF-18 NFAF ab Tibble Fork Res. | 06/12/00 | <5.0 | <1.0 | <12.0 | 47.5 | <5.0 | <30.0 | | <3.0 | <1.0 | 16.8 | <1 | <0.2 | <5.0 | 48.8 | 34 | 1.96 | <2.0 | 60.2 | 190.9 | 7.5 | 8.38 |
| AF-18 NFAF ab Tibble Fork Res. | 07/18/00 | <1.0 | 5.8 | <3.0 | | <5.0 | 1 | 93 | <20.0 | 25.6 | <1 | <2.0 | 34.8 | 53.8 | <12.0 | <1.0 | 188 | 2.32 | 25.1 | 526 | 8 | 8.34 |
| AF-18 NFAF ab Tibble Fork Res. | 08/17/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | <30.0 | <5.0 | <20.0 | 25.6 | <1 | <2.0 | 43.3 | 82.4 | <5.0 | 3.15 | <1.0 | | 310.9 | 7.8 | 8.34 |
| AF-18 NFAF ab Tibble Fork Res. | 09/26/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | <30.0 | <5.0 | <20.0 | 27.4 | <1 | <2.0 | 47.5 | 72.1 | <5.0 | 2.74 | 1.2 | | 292.6 | 7.93 | 8.29 |
| AF-19 NFAF bl Tibble Fork Reservoir | 06/15/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | 38.7 | <30.0 | <5.0 | 27 | 14.1 | <1 | <2.0 | 63.4 | 48.5 | 8.9 | 2.13 | <1.0 | 73.7 | 179 | 8.1 | 8.44 |
| AF-19 NFAF bl Tibble Fork Reservoir | 09/19/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | <30.0 | <5.0 | 23.6 | 22.9 | | <2.0 | 62.7 | 73.9 | 8.3 | | <1.0 | | 278.6 | 7.54 | 8.29 |
| AF-20 NFAF ab confl. W/ SFAF | 06/20/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | <30.0 | <5.0 | <20.0 | 15.7 | <1 | <2.0 | 59.5 | 50.5 | 6.4 | 1.69 | <1.0 | | 190.6 | 8.42 | 8.54 |
| AF-20 NFAF ab confl. W/ SFAF | 07/18/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | <30.0 | <5.0 | <20.0 | 21.5 | <1 | <2.0 | 61.1 | 66.2 | <5.0 | 2.36 | <1.0 | 33.9 | 253.6 | 8.1 | 8.45 |
| AF-20 NFAF ab confl. W/ SFAF | 08/17/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | <30.0 | <5.0 | 26.5 | 21.8 | 1.28 | <2.0 | 59.2 | 69 | 5.4 | 11 | <1.0 | | 261.9 | 8.2 | 8.51 |
| AF-20 NFAF ab confl. W/ SFAF | 09/27/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | <30.0 | <5.0 | <20.0 | 21.5 | <1 | <2.0 | 65 | 63.7 | <5.0 | 2.74 | <1.0 | | 247.4 | 8.26 | 8.51 |
| AF-21 AF @ mouth of canyon | 06/23/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | <30.0 | <5.0 | <20.0 | 16.3 | <1 | <2.0 | 57.3 | 54.9 | <5.0 | 2.25 | <1.0 | | 204 | 7.4 | 8.53 |
| AF-21 AF @ mouth of canyon | 09/19/00 | <5.0 | <1.0 | <12.0 | <0.2 | <3.0 | <30.0 | <30.0 | <5.0 | <20.0 | 22 | | <2.0 | 53.8 | 66 | <5.0 | | <1.0 | | 255.2 | 7.81 | 8.44 |

| 2000 WATER MONITORING IN AFC TOTAL METALS | Date | T-As | T-Cd | T-Pb | T-Hg | T-Zn | T-Cu | T-Ag | T-Al | T-Ba | T-Cr | T-Fe | T-Mn | T-Se | Flow | T. Hardns. | Field pH | Lab pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site Name | MMDDYY | ug/l | ug/l | ug/l | ug/l | ug/l | ug/l | ug/l | ug/l | mg/l | ug/l | mg/l | ug/l | ug/l | cfs | mg/l | | |
| AF-5 NFAF ab Pacific Mine | 06/06/00 | <5.0 | <1 | 3.9 | <0.2 | 41.6 | <12.0 | <2.0 | 116 | 0.041 | <5.0 | 0.2 | 14.5 | <1.0 | 28.1 | 88 | 7.9 | 8.02 |
| AF-5 NFAF ab Pacific Mine | 07/19/00 | | | | | | | | | | | | | | 2.1 | 128.5 | 8.1 | 8.26 |
| AF-5 NFAF ab Pacific Mine | 08/23/00 | | | | | | | | | | | | | | | 112.3 | 7.9 | 8.12 |
| AF-5 NFAF ab Pacific Mine | 09/25/00 | <5.0 | <1 | <3.0 | <0.2 | 56 | <12.0 | <2.0 | 92.6 | 0.045 | 240 | 0.38 | 55.9 | <1.0 | | 111.2 | 7.86 | 8.13 |
| AF-6 Pacific Mine Adit | 06/01/00 | 11.9 | 10.1 | 12.9 | <0.2 | 1330 | 24.5 | <2.0 | 85.9 | 0.082 | <5.0 | 2.22 | 7.2 | 1.1 | 0.9 | 215 | 8 | 7.74 |
| AF-6 Pacific Mine Adit | 07/24/00 | | | | | | | | | | | | | | 1.4 | 199.5 | 7.2 | 7.23 |
| AF-6 Pacific Mine Adit | 08/22/00 | | | | | | | | | | | | | | | 207.9 | 7.2 | 7.44 |
| AF-6 Pacific Mine Adit | 09/20/00 | | | | | | | | | | | | | | | 202.2 | 6.52 | 7.56 |
| AF-7 Spring Near Pacific Mine | 06/07/00 | <5.0 | <1 | <3.0 | <0.2 | <30.0 | <12.0 | <2.0 | <30 | 0.1 | <5.0 | 0.03 | <5.0 | <1.0 | 0.1 | 211.2 | 7.4 | 7.49 |
| AF-8 Pacific Mine Beaver Pond Outlet to NFAF | 06/07/00 | <5 | 4.6 | 6.8 | <.2 | 618 | <12 | <2 | 33.5 | 0.1 | <5.0 | 0.53 | 30.7 | <1.0 | 0.1 | 252 | 7.7 | 7.93 |
| AF-8 Pacific Mine Beaver Pond Outlet to NFAF | 09/27/00 | | | | | | | | | | | | | | | 195 | 7.58 | 7.96 |
| AF-9A Pacific Mine Upper Tailings Discharge | 06/07/00 | 18.1 | 9.4 | 1540 | <0.2 | 1090 | 21 | 4.4 | 79.4 | 0.2 | <5.0 | 1.54 | 44.6 | 1.6 | 0.03 | 231.5 | 7.7 | 8.09 |
| AF-9A Pacific Mine Upper Tailings Discharge | 09/20/00 | | | | | | | | | | | | | | | 201.7 | 7.62 | 8.34 |
| AF-9B Discharge from Tailings, Middle | 06/07/00 | 24.4 | 13.9 | 1710 | <0.2 | 1640 | 233.2 | 4.7 | 171 | 0.3 | <5.0 | 2.84 | 8.8 | 1.7 | 0.3 | 228.7 | 7.8 | 8.22 |
| AF-9C Pacific Mine Discharge from Lower Tailings | 06/07/00 | 34.8 | 31.3 | 1720 | <0.2 | 2740 | 41.4 | 7.1 | 165 | 0.6 | <5.0 | 2.24 | 13.2 | 8.2 | 0.01 | 225.4 | 7.6 | 8.07 |
| AF-10 NFAF bl Pacific Mine | 06/06/00 | <5.0 | <1 | 42.3 | <0.2 | 74.8 | <12.0 | <2.0 | 143 | 0.078 | <5.0 | 0.3 | 18.6 | <1.0 | 35 | 93.5 | 7.6 | 8.15 |
| AF-10 NFAF bl Pacific Mine | 07/19/00 | | | | | | | | | | | | | | 5 | 140.3 | 8.2 | 8.37 |
| AF-10 NFAF bl Pacific Mine | 08/23/00 | | | | | | | | | | | | | | | 149.2 | 7.8 | 8.19 |
| AF-10 NFAF bl Pacific Mine | 09/25/00 | <5.0 | <1 | 12.7 | <0.2 | 95.4 | <12.0 | <2.0 | 83.6 | 0.046 | <5.0 | 0.25 | 30.9 | <1.0 | | 147.6 | 7.94 | 8.38 |
| AF-11 NFAF @ Dutchman Flat ab Mary Ellen | 06/07/00 | <5.0 | <1 | 30.3 | <0.2 | 70.8 | <12.0 | <2.0 | 124 | 0.05 | <5.0 | 0.24 | 16.7 | 1.7 | 35.5 | 118.6 | 8 | 8.26 |
| AF-11 NFAF @ Dutchman Flat ab Mary Ellen | 07/19/00 | | | | | | | | | | | | | | 6.5 | 158.2 | 8.2 | 8.45 |
| AF-11 NFAF @ Dutchman Flat ab Mary Ellen | 08/22/00 | | | | | | | | | | | | | | | 162.1 | 8.4 | 8.44 |
| AF-11 NFAF @ Dutchman Flat ab Mary Ellen | 09/25/00 | <5.0 | <1 | 25.5 | <0.2 | 62.1 | <12.0 | <2.0 | 66.8 | 0.052 | <5.0 | 0.19 | 19.3 | <1.0 | | 167.1 | 8.05 | 8.46 |
| AF-11A NFAF bl Shaffer, ab Mary Ellen | 06/08/00 | | | | | | | | | | | | | | 37.1 | 115.5 | 8.2 | 8.21 |
| AF-12 NFAF bl Mary Ellen | 06/07/00 | | | | | | | | | | | | | | 44.4 | 118 | 8.26 | 8.19 |
| AF-12 NFAF bl Mary Ellen | 07/19/00 | | | | | | | | | | | | | | 7.6 | 154.4 | 8.2 | 8.44 |
| AF-12 NFAF bl Mary Ellen | 08/22/00 | | | | | | | | | | | | | | | 165 | 9 | 8.47 |
| AF-12 NFAF bl Mary Ellen | 09/26/00 | <5.0 | <1 | 37.4 | <0.2 | 81.8 | <12.0 | <2.0 | 81.1 | 0.06 | <5.0 | 0.19 | 28.3 | <1.0 | | 159.1 | 8.03 | 8.39 |
| AF-13 NFAF ab Major Evans | 06/08/00 | | | | | | | | | | | | | | 41.6 | 120.3 | 8.05 | 8.31 |
| AF-13 NFAF ab Major Evans | 09/19/00 | | | | | | | | | | | | | | | 172.5 | 7.95 | 8.59 |
| AF-14 Major Evans @ Mouth ab NF | 06/08/00 | | | | | | | | | | | | | | 7.4 | 189.1 | 8.1 | 8.61 |
| AF-14 Major Evans @ Mouth ab NF | 09/19/00 | | | | | | | | | | | | | | | 181.1 | 7.98 | 8.66 |
| AF-15 NFAF bl Major Evans | 06/08/00 | | | | | | | | | | | | | | 42 | 126.1 | 7.9 | 8.37 |
| AF-15 NFAF bl Major Evans | 09/19/00 | | | | | | | | | | | | | | | 170.5 | 7.96 | 8.55 |
| AF-16 NFAF ab Silver Creek Confluence | 06/08/00 | | | | | | | | | | | | | | 48.5 | 130.6 | 7.98 | 8.32 |
| AF-16 NFAF ab Silver Creek Confluence | 09/27/00 | | | | | | | | | | | | | | | 178.7 | 8.05 | 8.4 |
| AF-17 NFAF bl Silver Creek | 06/15/00 | <5 | <1 | 13.3 | <.2 | 65.2 | <12 | <2 | 63.3 | 0.04 | <5.0 | 0.16 | 9.4 | <1 | 44.6 | 123.5 | 8.3 | 8.45 |
| AF-17 NFAF bl Silver Creek | 07/18/00 | | | | | | | | | | | | | | 10.5 | 180.6 | 8.4 | 8.55 |
| AF-17 NFAF bl Silver Creek | 08/22/00 | | | | | | | | | | | | | | | 186.8 | 8.4 | 8.39 |
| AF-17 NFAF bl Silver Creek | 09/26/00 | <5.0 | <1 | 9.2 | <0.2 | 57.1 | <12.0 | <2.0 | 36.6 | 0.051 | <5.0 | 0.09 | 6.1 | <1.0 | | 180.4 | 8.22 | 8.46 |
| AF-18 NFAF ab Tibble Fork Res. | 06/12/00 | <5.0 | <1 | 10.3 | <0.2 | 52.1 | <12.0 | <2.0 | 49.7 | 0.04 | <5.0 | 0.12 | 6.3 | <1.0 | 60.2 | 190.9 | 7.5 | 8.38 |
| AF-18 NFAF ab Tibble Fork Res. | 07/18/00 | | | | | | | | | | | | | | 25.1 | 526 | 8 | 8.34 |
| AF-18 NFAF ab Tibble Fork Res. | 08/17/00 | | | | | | | | | | | | | | | 310.9 | 7.8 | 8.34 |
| AF-18 NFAF ab Tibble Fork Res. | 09/26/00 | <5.0 | <1 | <3.0 | <0.2 | 31.7 | <12.0 | <2.0 | <30 | 0.042 | <5.0 | 0.03 | <5.0 | <1.0 | | 292.6 | 7.93 | 8.29 |
| AF-19 NFAF bl Tibble Fork Reservoir | 06/15/00 | <5.0 | <1 | 4.2 | <0.2 | 39.5 | <12.0 | <2.0 | <30 | 0.048 | <5.0 | 0.08 | 11 | <1.0 | 73.7 | 179 | 8.1 | 8.44 |
| AF-19 NFAF bl Tibble Fork Reservoir | 09/19/00 | | | | | | | | | | | | | | | 278.6 | 7.54 | 8.29 |
| AF-20 NFAF ab confl. W/ SFAF | 06/20/00 | <5.0 | <1 | 5.3 | <0.2 | 55.1 | <12.0 | <2.0 | 68.3 | 0.041 | <5.0 | 0.11 | 12.8 | <1.0 | | 190.6 | 8.42 | 8.54 |
| AF-20 NFAF ab confl. W/ SFAF | 07/18/00 | | | | | | | | | | | | | | 33.9 | 253.6 | 8.1 | 8.45 |
| AF-20 NFAF ab confl. W/ SFAF | 08/17/00 | | | | | | | | | | | | | | | 261.9 | 8.2 | 8.51 |
| AF-20 NFAF ab confl. W/ SFAF | 09/27/00 | | | | | | | | | | | | | | | 247.4 | 8.26 | 8.51 |
| AF-21 AF @ mouth of canyon | 06/23/00 | | | | | | | | | | | | | | | 204 | 7.4 | 8.53 |
| AF-21 AF @ mouth of canyon | 09/19/00 | | | | | | | | | | | | | | | 255.2 | 7.81 | 8.44 |

# American Fork AML Water Quality M

| Site Name | Date Sampled | Field Parameters | | | | | | | Dissolved Metals (mg/L) | | | | | | | | Cations (mg/L) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Temp °C | pH | Conductivity (µmhos/cm) | CO3 | CO3(mg/L) | HCO3 | HCO3 (mg/L) | Aluminum | Arsenic | Cadmium | Copper | Iron | Lead | Nickel | Zinc | Calcium | Magnesium | Potassium |
| SW-NF>LB | 7/20/2004 | 13.8 | 8.6 | 160.8 | 0 | | 80 | | -- | -- | -- | -- | 0.092 | -- | -- | 0.012 | 24 | 8.5 | -- |
| | 9/22/2004 | 6.5 | 7.7 | 183.8 | | | | | -- | -- | -- | -- | 0.110 | -- | -- | 0.011 | 28 | 10 | -- |
| MD-LBAD | 7/20/2004 | 10.8 | 5.6 | 135.1 | 0 | | 5 | | 0.17 | -- | 0.011 | 0.018 | 7.2 | -- | 0.010 | 0.570 | 11 | 3.5 | 1.2 |
| | 9/22/2004 | 8.8 | 5.7 | 111.3 | | | | | 0.25 | -- | 0.009 | 0.016 | 6.100 | -- | 0.009 | 0.440 | 8.8 | 3.1 | 1.1 |
| MD<LBAD | 7/20/2004 | 15.2 | 7.7 | 43.2 | 0 | | 7 | | -- | -- | -- | -- | 0.069 | -- | -- | 0.016 | 5.6 | 1.8 | -- |
| | 9/22/2004 | 10.4 | 4.5 | 112.0 | | | | | 0.53 | -- | 0.011 | 0.013 | 0.110 | -- | 0.009 | 0.440 | 9.6 | 3.1 | 1.1 |
| SW-NF<LB | 7/20/2004 | 18.3 | 7.7 | 44.3 | 0 | | 66 | | -- | -- | -- | -- | 0.070 | -- | -- | 0.019 | 26 | 9.4 | -- |
| | 9/22/2004 | 7.4 | 7.6 | 162.5 | | | | | -- | -- | -- | -- | -- | -- | -- | 0.014 | 25 | 9.3 | -- |
| SW-NF>PM | 7/20/2004 | 18.8 | 8.5 | 217.0 | 0 | | 97 | | -- | -- | -- | -- | -- | -- | -- | 0.014 | 31 | 13 | -- |
| | 9/23/2004 | 8.7 | 8.2 | 207.0 | | | | | -- | -- | -- | -- | -- | -- | -- | -- | 29 | 13 | -- |
| MD-PMAD | 7/20/2004 | 15.9 | 7.1 | 350.0 | 0 | | 146 | | -- | -- | 0.021 | 0.007 | 0.100 | -- | 0.007 | 2.500 | 42 | 23 | -- |
| | 9/22/2004 | 7.3 | 6.9 | 273.0 | | | | | -- | -- | 0.011 | 0.005 | -- | -- | 0.006 | 1.400 | 40 | 22 | -- |
| MD-PMPD1 | 7/20/2004 | 19.9 | 8.2 | 384.0 | 0 | | 167 | | -- | -- | 0.0060 | -- | -- | -- | -- | 0.410 | 46 | 24 | -- |
| | 9/22/2004 | 8.9 | 8.9 | 257.0 | | | | | -- | -- | -- | -- | -- | -- | -- | 0.087 | 38 | 21 | -- |
| MD-PMPD4 | 7/20/2004 | 26.2 | 8.7 | 352.0 | 0 | | 160 | | -- | -- | -- | -- | -- | -- | -- | 0.023 | 41 | 22 | -- |
| | 9/22/2004 | 7.6 | 8.6 | 255.0 | | | | | -- | -- | -- | -- | -- | -- | -- | 0.025 | 35 | 22 | -- |
| SW-NF<PM | 7/20/2004 | 18.4 | 8.5 | 224.0 | 0 | | 107 | | -- | -- | -- | -- | -- | -- | -- | 0.023 | 28 | 12 | -- |
| | 9/22/2004 | 6.9 | 8.1 | 204.0 | | | | | -- | -- | -- | 0.073 | -- | -- | -- | -- | 31 | 15 | -- |
| SW-NF>DF | 7/20/2004 | 19.5 | 8.7 | 262.0 | 0 | | 128 | | -- | -- | -- | -- | -- | -- | -- | 0.012 | 33 | 15 | -- |
| | 9/22/2004 | 6.9 | 8.7 | 235.0 | | | | | -- | -- | -- | -- | -- | -- | -- | -- | | | -- |
| SW-NF<DF | 7/20/2004 | 19.0 | 8.8 | 257.0 | 0 | | 129 | | -- | -- | -- | -- | -- | -- | -- | 0.010 | 35 | 16 | -- |
| | 9/22/2004 | 7.0 | 8.4 | 229.0 | | | | | -- | -- | -- | -- | -- | -- | 0.006 | 0.013 | 38 | 18 | -- |
| | | | | | | Laboratory Detection Limit | | | 0.1 | 0.005 | 0.004 | 0.004 | 0.05 | 0.005 | 0.005 | 0.100 | 1.0 | 1.0 | 1.0 |

*As CaCO3

**Sample expired upon lab's receipt.

# lonitoring 2004

| | Anions (mg/L) | | | Nutrients (as N) (mg/L) | | | Other (mg/L or noted) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sodium | Sulfate | Chloride | nitrate/ nitrite | Ammonia | Nitrate | Nitrite | TSS | Turbidity (NTU) | Bicarbonate* | Carbonate* | Hardness* | Conductivity (µmhos) | pH @ 25°C |
| 1.0 | 19 | -- | 0 280 | 0.078 | 0.280 | -- | 4.0 | 1.60 | 73 | -- | 94 | 170 | 8.04** |
| -- | 34 | -- | 0.320 | 0.280 | 0.280 | -- | -- | 1.40 | 110 | -- | 110 | | |
| 1.7 | 45 | -- | -- | -- | -- | -- | 5.0 | 1.60 | -- | -- | 41 | 150 | 4.19** |
| 1.3 | 46 | -- | 0.010 | 0.100 | 0.043 | -- | -- | 0.34 | -- | -- | 35 | | |
| 1.2 | 10 | -- | 0.019 | -- | -- | -- | 25.0 | 15.00 | 13 | -- | 21 | 45 | 7.34** |
| 1.3 | 46 | -- | 0.010 | -- | -- | -- | 3.8 | -- | -- | -- | 37 | | |
| 1.0 | 16 | -- | 0.250 | 0.077 | 0.250 | -- | 4.0 | 0.89 | 86 | -- | 100 | 190 | 8.08** |
| 1.0 | 35 | -- | 0.200 | -- | 0.200 | -- | 3.4 | 2.10 | 110 | -- | 100 | | |
| 1.2 | 10 | -- | 0.300 | 0.064 | 0.300 | -- | 4.0 | 1.20 | 110 | -- | 130 | 220 | 8.25** |
| 1.4 | 14 | -- | 0.120 | 0.089 | 0.120 | -- | -- | 0.32 | 130 | -- | 130 | | |
| 1.5 | 42 | -- | 0.220 | -- | -- | -- | 17.0 | 10.00 | 160 | -- | 200 | 360 | 7.15** |
| 1.3 | 35 | -- | 0.220 | -- | 0.220 | -- | 9.4 | 5.50 | 200 | -- | 190 | | |
| 1.5 | 34 | -- | 0.028 | -- | -- | -- | -- | 0.48 | 180 | -- | 210 | 330 | 8.03** |
| 1.3 | 33 | -- | 0.081 | -- | 0.065 | -- | -- | 1.00 | 180 | -- | 180 | | |
| 1.5 | 34 | -- | 0.021 | -- | -- | -- | 7.0 | 11.00 | 160 | -- | 190 | 310 | 8.48** |
| 1.4 | 35 | -- | 0.120 | -- | 0.110 | -- | 15.0 | 20.00 | 180 | -- | 180 | | |
| 1.1 | 9.4 | -- | 0.130 | 0.088 | 0.130 | 0.130 | 5.0 | 1.60 | 100 | -- | 120 | 220 | 8.18** |
| 1.1 | 14 | -- | 0.120 | -- | 0.980 | -- | -- | 0.31 | 170 | -- | 140 | | |
| 1.2 | 9.4 | -- | 0.120 | 0.082 | 0.120 | -- | 4.0 | 2.10 | 130 | -- | 140 | 250 | 8.30** |
| 35 | 11 | -- | 0.120 | -- | 0.110 | -- | -- | 0.64 | 220 | -- | 150 | | |
| 1.3 | 9.4 | -- | 0.110 | 0.076 | 0.110 | -- | 8.0 | 0.90 | 140 | -- | 150 | 250 | 8.31** |
| 1.5 | 11.0 | -- | 0.110 | 0.060 | 0.096 | -- | -- | 0.31 | 290 | -- | 170 | | |
| 1 0 | 5.0 | 5 | 0.010 | 0.060 | 0.010 | 0.010 | 3.0 | 0.1 | 10 | 10 | 10 | | |

# APPENDIX B

## Metal Concentration Tables

Metal Concentrations in Soils at Pacific Mine Site
Metals Concentrations in Soils at Scotchman #2

Source:

Uinta National Forest
XRF Sampling Reports
2000 and 2001

# Metal Concentrations in Soils at Pacific Mine Site

**XRF Samples** Ted V. Fitzgerald, FS
Linda Calton, BOR

Content in Parts Per Million

| FS ID # | Location | Date | Method | Rb | Pb | As | Hg | Zn | Cu | Fe | Ba | Sb | Cd | Mn | Sn | Mo | Zr | Sr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | Waste Rock | 5/24/00 | In-Situ | 27 | 1699 | 237 | * | 787 | * | 5187 | 374 | * | * | * | 142 | * | 70 | 21 |
| 15 | Waste Rock | 5/24/00 | In-Situ | 203 | 290 | 82 | * | 169 | * | 23795 | 320 | * | * | * | 88 | 16 | 242 | 60 |
| 16 | Waste Rock | 5/24/00 | In-Situ | * | 5328 | * | * | 4029 | * | 4669 | 1600 | * | * | * | 120 | * | 27 | 16 |
| 17 | Waste Rock | 5/24/00 | In-Situ | * | 3770 | * | * | 4250 | * | 3149 | 5168 | * | 88 | * | 137 | * | 35 | 61 |
| | | | | | | | | | | | | | | | | | | |
| 22 | Tailings | 10/17/00 | In-Situ | * | 391 | * | * | 382 | * | 14093 | | | | 3587 | | | 179 | 45 |
| 23 | Tailings | 10/17/00 | In-Situ | * | 5267 | 573 | * | 487 | 331 | 14195 | | | | 2699 | | | 71 | * |
| 24 | Tailings | 10/17/00 | InSitu | 142 | 17190 | 1180 | 372 | 4218 | * | 18496 | | | | * | | | 76 | * |
| | | | | | | | | | | | | | | | | | | |

* <LOD Measurement result does not exceed the detection limit

**1999 Soil Sample Data - Pacific Tailings**
*Tailings* Bob Gecy, FS

| Sample | Sample Depth | Depth To Clay | Texture | ab/bl clay | Pb | As | Hg | Zn | Cu | Fe | Ba | Sb | Cd | Mn | Ag | Al | K | Mg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PM T1-1 | 1.85 | >1.85 | sand | ab | 21000 | 10.1 | 16.1 | 19800 | 86.5 | 4910 | 957 | 297 | 157 | 2.9 | 62.6 | 386 | 530 | 58.8 |
| PM T1-5 | 0.48 | >0.85 | sand | ab | 10800 | 146 | 9.3 | 4940 | 64.3 | 6250 | 1910 | 55.7 | 33.5 | 4.5 | 36.7 | 417 | <290 | 34 |
| PM T1-11 | 3.7 | >3.7 | sand | ab | 5600 | 33.6 | 4.4 | 2630 | 66.3 | 5320 | 993 | 54.9 | 19.4 | 1.1 | 23.4 | 211 | 360 | 15.8 |
| PM T2-3A | 1.25 | 1.5 | sand | ab | 15400 | 324 | 7.0 | 2380 | 47.9 | 14900 | 3240 | 82 | 15.7 | 1.3 | 55.5 | 229 | 390 | 11.6 |
| PM T2-7 | 0.9 | 0.6 | sand | ab | 5430 | 216 | 9.5 | 4960 | 135 | 16100 | 2020 | 40 | 35.2 | 282 | 34.8 | 5080 | 1100 | 1450 |
| PM T2-9 | 1 | 1.2 | sand | ab | 12100 | 161 | 17.9 | 18300 | 132 | 9130 | 2680 | 70.6 | 108 | 6.4 | 128 | 506 | 390 | 53.3 |
| PM T2-10B | 0.6 | 2.7 | sand | ab | 8360 | 6.4 | 7.8 | 3550 | 136 | 14400 | 2340 | 76.6 | 23.4 | 3.4 | 45.3 | 454 | 430 | 40.7 |
| PM T1-3 | 1.65 | 1.4 | sand | bl | 13600 | 258 | 7.3 | 2560 | 72.3 | 9050 | 1240 | 97 | 17 | 0.8 | 48.8 | 139 | 510 | 14.7 |
| PM T1-10 | 3.0 | 0.8 | sand | bl | 10800 | 66.8 | 8.0 | 4540 | 268 | 13300 | 1300 | 104 | 33.4 | 2.5 | 53.5 | 648 | 890 | 45.3 |
| PM T2-3B | 3.0 | 2.0 | sand | bl | 18100 | 394 | 14.3 | 11100 | 991 | 22900 | 1740 | 156 | 93 | 6.3 | 111 | 939 | 790 | 83.1 |
| PM T1-2 | 2.0 | 2.0 | clay | clay | 41800 | 218 | 11.8 | 3130 | 321 | 12100 | 1710 | 146 | 23.6 | 2.5 | 116 | 504 | 490 | 27.5 |
| PM T1-7 | 1.25 | 1.1 | clay | clay | 12000 | 51.2 | 8.6 | 3230 | 92.4 | 6930 | 2560 | 35.4 | 22.1 | 3.4 | 28.3 | 326 | 500 | 18 |
| PM T1-9 | 2.35 | 0.7 | clay | clay | 35700 | 9.6 | 15.3 | 3890 | 1010 | 25200 | 2640 | 140 | 30.3 | 6.3 | 123 | 1490 | 1100 | 76.8 |
| PM T2-2 | 0.6 | 0.6 | clay | clay | 27900 | 696 | 35.8 | 3540 | 315 | 21200 | 1650 | 142 | 23.6 | 3.9 | 118 | 248 | 480 | 22.7 |
| PM T2-5 | 1.35 | 1.5 | clay | clay | 24100 | 7.6 | 17.3 | 5640 | 214 | 18300 | 1640 | 100 | 39.2 | 4.7 | 115 | 794 | 780 | 51.5 |
| PM T2-10A | 2.9 | 2.7 | clay | clay | 14500 | 46 | 9.2 | 4560 | 1410 | 24500 | 973 | 185 | 35.1 | 2.4 | 87.5 | 214 | 450 | 12.6 |
| Average | | | | | 17324 | 165 | 12 | 6047 | 335 | 14031 | 1848 | 111 | 44 | 21 | 75 | 787 | 613 | 125 |

## HEAVY METAL CONCENTRATIONS IN SCOTCHMAN #2

### SCOTCHMAN #2 WASTE ROCK PILE

| LOCATION | FS Id. # | XL # Cd | XL # Am | Date | Method | Mo ppm | Zr ppm | Sr ppm | Rb ppm | Pb ppm | Se ppm | As ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scotchman #2 | 1 | 469 | 470 | 6/15/00 | In Situ | <LOD | 63 ± 6 | 83 ± 8 | 29 ± 6 | 1979 ± 63 | <LOD | 97 ± 53 |
| Scotchman #2 | 2 | 471 | 472 | 6/15/00 | In Situ | 12 ± 5 | 139 ± 7 | 56 ± 7 | 141 ± 11 | 1040 ± 42 | <LOD | <LOD |
| Scotchman #2 | 3 | 473 | 474 | 6/15/00 | In Situ | <LOD | <LOD | 26 ± 7 | 31 ± 8 | 464 ± 35 | <LOD | <LOD |

| LOCATION | FS Id. # | XL # Cd | XL # Am | Date | Method | Zn ppm | Cu ppm | Ni ppm | Co ppm | Fe ppm | Mn ppm | Ba ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scotchman #2 | 1 | 469 | 470 | 6/15/00 | In Situ | 880 ± 61 | <LOD | <LOD | <LOD | 24192 ± 660 | 998 ± 460 | 317 ± 65 |
| Scotchman #2 | 2 | 471 | 472 | 6/15/00 | In Situ | 285 ± 39 | <LOD | <LOD | <LOD | 17498 ± 510 | <LOD | 819 ± 85 |
| Scotchman #2 | 3 | 473 | 474 | 6/15/00 | In Situ | 596 ± 60 | <LOD | <LOD | <LOD | 28698 ± 820 | <LOD | 63 ± 32 |

| LOCATION | FS Id. # | XL # Cd | XL # Am | Date | Method | Sn ppm | Ag ppm | Sb ppm | Cd ppm | Hg ppm | Cr ppm | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scotchman #2 | 1 | 469 | 470 | 6/15/00 | In Situ | 154 ± 64 | <LOD | <LOD | <LOD | <LOD | <LOD | |
| Scotchman #2 | 2 | 471 | 472 | 6/15/00 | In Situ | 128 ± 52 | <LOD | <LOD | <LOD | <LOD | <LOD | |
| Scotchman #2 | 3 | 473 | 474 | 6/15/00 | In Situ | 140 ± 58 | <LOD | <LOD | <LOD | <LOD | <LOD | |

# APPENDIX C

## Applicable or Relevant and Appropriate Requirements – AFC Site

Contaminant-Specific Applicable or Relevant and Appropriate Requirements
Location-Specific Applicable or Relevant and Appropriate Requirements
Action-Specific Applicable or Relevant and Appropriate Requirements

Source:

Uinta National Forest
Engineering Evaluation and Cost Analysis
for AFC Mine Reclamation Project
2002

**Contaminant-Specific Applicable or Relevant and Appropriate Requirements**
**American Fork Canyon Site**

| Standard, Requirement Criteria, or Limitation | Citation | Description | Applicable/Relevant and Appropriate? |
|---|---|---|---|
| **Federal** | | | |
| **Safe Drinking Water Act** | 40 USC § 300 | | |
| National Primary Drinking Water Regulations | 40 CFR Part 141 | Establishes health-based standards, maximum contaminant levels (MCLs), for public water systems. | Not an ARAR, treating groundwater is outside scope of removal action and there are no affected public water systems. |
| National Secondary Drinking Water Regulations | 40 CFR Part 143 | Establishes aesthetic standards (secondary MCLs) for public water systems. | Not an ARAR, these are not enforceable standards and are outside scope of removal action. |
| **Water Pollution Prevention & Control Act** | 33 USC §§ 1251-1387 | | |
| Ambient Water Quality Criteria | 40 CFR Part 131 | Sets criteria for water quality based on toxicity to aquatic organisms and human health. | Not an ARAR since the state has been delegated this program and has promulgated water quality standards for the designated beneficial uses. |
| **Clean Air Act** | 40 USC § 7409 | | |
| National Primary and Secondary Ambient Air Quality Standards | 40 CFR Part 50 | Establishes air quality levels that protect public health. | Not an ARAR – only "major" sources are subject to requirements related to NAAQS, defer to state regulation of emissions for particulate matter and lead. |
| **Resource Conservation and Recovery Act** | 40 USC § 7601 | | |
| Lists of Hazardous Wastes | 40 CFR Part 261, Subpart D and C | Defines those solids wastes which are subject to regulation as hazardous wastes under 40 CFR Parts 262-265 and Parts 124, 270, and 271. | Not an ARAR – mine waste is not listed, Bevill exempt. Even if TCLP testing confirmed a characteristic waste (Subpart C), it is still exempt. Other parts of the RCRA regulations may be relevant and appropriate, however, and are discussed under action-specific requirements. |

**Contaminant-Specific Applicable or Relevant and Appropriate Requirements**
**American Fork Canyon Site, Utah**

| Standard, Requirement Criteria, or Limitation | Citation | Description | Applicable/Relevant and Appropriate? |
|---|---|---|---|
| **State of Utah** | | | |
| **Utah Safe Drinking Water Act** | Title 19 UCA Chapter 4 | | |
| Utah Primary Drinking Water Standards | UAC R309-103-2 | Establishes maximum contaminant levels for inorganic and organic chemicals as primary drinking water standards. | Not an ARAR. Treating ground water is beyond the scope of this removal action, which is a source control action. Consolidating and capping the tailings will reduce the loading of contaminants to and prevent further degradation of ground water. |
| **Utah Water Quality Act** | Title 19 UCA Chapter 5 | | |
| Ground Water Quality Protection Rule | UAC R317-6 | Establishes ground water quality standards (R317-6-2). These are the same as Federal MCLs with a few exceptions, e.g., lead and copper. | Not an ARAR. Treating ground water is beyond the scope of this removal action, which is a source control action. However, consolidating and capping the tailings will reduce the loading of contaminants to and prevent further degradation of ground water. Ground water will be monitored for a period of years after the removal action. |
| Water Quality Standards | UAC R317-2 | Establishes standards for the quality of surface waters of the State. R317-2-6 defines use designations. R317-2-7 requires compliance with surface water numeric criteria. R307-2-13 classifies waters of the State. R317-2-14 provides numeric standards for water classes. | Not an ARAR. Although the removal of mine waste from the stream bank is expected to improve surface water quality, this removal action does not involve treating the surface water itself and no point source discharge will be created as a result of this removal action. Storm-water runoff requirements are discussed under action-specific ARARs. |

**Contaminant-Specific Applicable or Relevant and Appropriate Requirements**
**American Fork Canyon Site, Utah**

| Standard, Requirement Criteria, or Limitation | Citation | Description | Applicable/Relevant and Appropriate? |
|---|---|---|---|
| **Utah Solid and Hazardous Waste Act** | Title 19 UCA Chapter 6, Part 1 | | |
| Utah Hazardous Waste Definitions and References/Identification and Listing of Hazardous Waste | UAC R315-1 and R315-2 | Provides definitions, references, and identifies and lists hazardous wastes. | Not an ARAR – solid waste from the extraction, benefication, and processing of ores and minerals are not hazardous wastes under state regulations. Other parts of the state hazardous and solid waste regulations may be relevant and appropriate, however, and are discussed under action-specific requirements. |

**Location-Specific Applicable or Relevant and Appropriate Requirements**
**American Fork Canyon Site, Utah**

| Standard, Requirement Criteria, or Limitation | Citation | Description | Applicable/Relevant and Appropriate? |
|---|---|---|---|
| **Federal** | | | |
| **Resource Conservation and Recovery Act** | 40 USC § 7601 | | |
| Hazardous and Solid Waste Regulations | 40 CFR Part 264.18 | Location standards and restrictions for hazardous waste treatment, storage, and disposal (TSD) facilities | Not an ARAR since these are siting regulations and this removal action involves consolidating mine waste into an existing unit. |
| | 40 CFR §§ 257.3-1 through 257.3-4 | Location standards and restrictions for municipal solid waste (MSW) facilities. | Not an ARAR since these are siting regulations and this removal action involves consolidating mine waste into an existing unit. |
| **National Historic Preservation Act** | 16 USC § 470;<br>36 CFR Part 800<br><br>40 CFR 6.301(b) | Requires Federal Agencies to take into account the effect of any Federally assisted undertaking or licensing on any property with historic, architectural, archeological, or cultural value that is included in or eligible for inclusion in the National Register of Historic Places. | Applicable |
| **Archeological and Historic Preservation Act** | 16 USC § 469<br><br>40 CFR 6.301(c) | Establishes procedures to provide for preservation of significant scientific, prehistoric, historic, and archeological data that might be destroyed through alteration of terrain as a result of a Federal construction project or a Federally licensed activity or program. | Applicable |
| **Historic Sites Act** | 16 USC §§ 461-467<br>40 CFR 6.301(a) | Requires Federal agencies to consider the existence and location of potential and existing National Natural Landmarks to avoid undesirable impacts on them. | Applicable. However, there are no potential or existing National Natural Landmarks in the project area. |

**Location-Specific Applicable or Relevant and Appropriate Requirements**
**American Fork Canyon Site, Utah**

| Standard, Requirement Criteria, or Limitation | Citation | Description | Applicable/Relevant and Appropriate? |
|---|---|---|---|
| | 36 CFR 62 | | |
| **Protection of Wetlands Executive Order No. 11990** | 40 CFR Part 6; Appendix A,<br><br>40 CFR 6.302(a) | Avoid adverse impacts associated with the destruction or loss of wetlands and avoid support of new construction in wetlands if a practicable alternative exists. | Applicable. However, no destruction or loss of wetlands will result from removal action. |
| Dredge and Fill Regulations | 33 USC § 1344, 33 CFR 323.1 et. seq. | Prohibits discharge of dredged or fill material into waters of the United States without a permit | Substantive portions are applicable for stream reconstruction activities. |
| **Fish and Wildlife Coordination Act** | 16 USC Chapter 49, §§ 2901-2912;<br><br>40 CFR 6.302(g) | Requires consultation when Federal department or agency proposes or authorizes any modification of any stream or other water body to assure adequate protection of fish and wildlife resources. | Applicable |
| **Floodplain Management Executive Order No. 11988** | 40 CFR Part 6, Appendix A<br><br>40 CFR 6.302(b) | Requires Federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid the adverse impacts associated with direct and indirect development of a floodplain to the extent possible. | Applicable |
| **Endangered Species Act** | 16 USC §§ 1531-1543; 40 CFR 6.302 (h); 50 CFR Part 402 | Activities may not jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify a critical habitat. | Applicable. However, threatened or endangered species and critical habitat will not be jeopardized by this removal action. |
| **Bald Eagle Protection Act** | 16 USC §§ 668 et seq. | Requires continued consultation with the USFWS during remedial design and remedial construction to ensure that any cleanup of the site does not unnecessarily adversely affect the bald or golden eagle. | Applicable |
| **Migratory Bird Treaty Act** | 16 USC §§ 703 et seq. | Establishes federal responsibility for the protection of the international migratory | Applicable |

**Location-Specific Applicable or Relevant and Appropriate Requirements**
**American Fork Canyon Site, Utah**

| Standard, Requirement Criteria, or Limitation | Citation | Description | Applicable/Relevant and Appropriate? |
|---|---|---|---|
| | | bird resource and requires continued consultation with the USFWS during remedial design and remedial construction to ensure that the cleanup of the site does not unnecessarily impact migratory birds. | |
| **State of Utah** | | | |
| General Facility Standards: Location Standards for Hazardous Waste Facilities | UAC R315-8-2.9 | Establishes characteristics that make a site unsuitable for location of hazardous waste management units. State analog to 40 CFR 264.18. | Not an ARAR – not siting a new hazardous waste disposal facility. |

**Action-Specific Applicable or Relevant and Appropriate Requirements**
**American Fork Canyon Site, Utah**

| Standard, Requirement Criteria, or Limitation | Citation | Description | Applicable/Relevant and Appropriate? |
|---|---|---|---|
| **Federal** | | | |
| **Clean Water Act** | 33 USC § 1342 | | |
| National Pollutant Discharge Elimination System | 40 CFR Part 122.26 | In general, Part 122 provides permit requirements for the discharge of pollutants from any point source into waters of the United States. Part 122.26 requires permits for storm-water discharges. | Not an ARAR for the consolidation and capping portion of the remedy because regulation of storm-water runoff from mining operations where there is no contact with contaminated material is excluded from 122.26. Regulation of storm-water runoff during construction would be an ARAR, if there were no state program. Will defer to state requirements for storm-water control at UAC 317-8. |
| **Surface Mining Control and Reclamation Act** | 30 USC §§ 1201-1328 | Performance standards for surface mining activities. | Not an ARAR since this is not a coal mine and would defer to requirements under Utah's program for mine reclamation even if it were a coal mine. However, Utah did not identify any reclamation regulations. |
| **Hazardous Materials Transportation Act**<br><br>Hazardous Materials Transportation Regulations | 49 USC §§ 1801-1813<br><br>49 CFR Parts 10, 171-177 | Regulates transportation of hazardous materials. | Not an ARAR. Beyond the scope of this removal action since no offsite transportation is contemplated. |
| **Resource Conservation and Recovery Act** | 46 USC § 7601 | | |
| Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal (TSD) Facilities | 40 CFR Part 264 | Requirements for proper handling, treatment, storage, and disposal of hazardous wastes. Part 264.258 (Subpart L) concerns closure of waste | Not an ARAR. Removal action will consolidate mine waste in an in-situ mine waste location, not create a RCRA TSD facility. Part 264.310(a), (b)(1) and (b)(5) |

**Action-Specific Applicable or Relevant and Appropriate Requirements**
**American Fork Canyon Site, Utah**

| Standard, Requirement Criteria, or Limitation | Citation | Description | Applicable/Relevant and Appropriate? |
|---|---|---|---|
| | | piles. If wastes remain after all reasonable efforts have been made to effect removal or decontamination of wastes in waste piles, then closure will be per the landfill closure regulations at Part 264.310 (Subpart N). Part 264.554 concerns staging piles. This part was identified as an ARAR by Utah. | relating to closure, caps, and run-on/run-off controls would be relevant and appropriate except that the state solid waste and mine reclamation regulations provide specific guidelines. The Part 264 closure requirements are general in nature. The substantive portions of Part 264.554 concerning staging piles may be relevant and appropriate if staging piles are used during the course of the removal action. |
| Land Disposal Restrictions | 40 CFR Part 268 | Discusses the land ban. | Not an ARAR for reasons given concerning Parts 261 and 264. |
| Criteria for Municipal Solid Waste (MSW) Landfills | 40 CFR Part 258.50-56 | Requirements for engineered disposal facilities to ensure appropriate assessment, monitoring, and protection of groundwater. | Would be relevant and appropriate to the post-removal ground water monitoring program if there was no state-delegated program. Will defer to state requirements. |
| | 40 CFR Part 258.60(a)(1-3) | Closure criteria for MSW facilities. | Provides criteria for cover permeability, depth of infiltration layer, and depth and quality of erosion layer. Would be relevant and appropriate if there was no state-delegated program. Will defer to state closure requirements at UAC R315-303-3(4). |

**Action-Specific Applicable or Relevant and Appropriate Requirements**
**American Fork Canyon Site, Utah**

| State of Utah | | | |
|---|---|---|---|
| **UCA 73-3-25** | | Establishes standards for drilling and abandonment of wells. | Applicable when ground water monitoring wells are closed. |
| **Utah Air Conservation Act** | Title 19 UCA Chapter 2 | | |
| General Requirements for Air Conservation | UAC R307-101 | Provides definitions. | Not an ARAR – only provides definitions. |
| Davis, Salt Lake and Utah Counties, Ogden City and any non-attainment area for PM 10: Fugitive Emissions and Fugitive Dust | UAC R307-309 | Specific requirements for fugitive dust control. American Fork Canyon is in Utah County. | Substantive requirements are applicable such as suggested dust control strategies and limits on vehicular traffic on unpaved roads. |
| Conditions for Issuing Approval Orders | UAC R307-401-6 | Requirements for implementation of Best Available Control Technology (BACT) and compliance with National Primary and Secondary Ambient Air Quality Standards (NAAQS). | Not an ARAR – removal action will not create a source of regulated air pollutants except fugitive dust that is regulated under UAC R307-309. |
| Emission Impact Analysis | UAC R307-410 | An evaluation of ambient air impacts related to toxic air pollutants is required. The rule defines procedures for developing toxic screening levels for air pollutants. | Not an ARAR – removal action will not create a facility that emits toxic air pollutants. |
| **Utah Solid and Hazardous Waste Act** | Title 19 UCA Chapter 6, Part 1 | | |
| Hazardous Waste Generator Requirements | UAC R315-5 | Outlines requirements for hazardous waste generators. State analog to 40 CFR Part 262. | Not an ARAR – no hazardous waste is expected to be generated as a result of this removal action. |
| Standards for Owners and | UAC R315-8 | Outlines requirements for hazardous | Not an ARAR. Removal action will |

| | | | |
|---|---|---|---|
| Operators of Treatment, Storage, and Disposal Facilities | | waste treatment, storage and disposal facilities (TSDFs). State analog to 40 CFR 264. | consolidate mine waste in an in-situ mine waste location, not create a RCRA TSD facility. Parts relating to closure, caps, and run-on/run-off controls may be relevant and appropriate – need to read this before deciding. |
| General Facility Standards: Construction Quality Assurance Program | UAC R315-8-2.10 | Establishes requirements for a construction quality assurance program to ensure that constructed units meet or exceed all design criteria. | Relevant and appropriate. A construction quality assurance program will be developed to ensure the removal action meets or exceeds all design criteria and specifications. |
| Ground Water Protection | UAC R315-8-6 | Describes ground water monitoring requirements and protection standards for TSDFs. State analog to 40 CFR Subpart F. | R315-8-6.8 concerning general ground water monitoring requirements is relevant and appropriate and will be used to develop the post removal monitoring program. |
| Closure/Post Closure Standards | UAC R315-8-7 | Establishes closure and post closure performance standards for TSDFs. Incorporates the Federal regulations at 40 CFR 264 Subpart G by reference. | The 40 CFR 264 Subpart G regulations that were incorporated by reference concern closure but they provide general guidelines only. Will defer to the relevant and appropriate state solid waste regulations for closure at R315-303-3(4) that provide final cover and grading requirements. Will also defer to the relevant and appropriate state solid waste regulations at R315-303-3(1)(d) concerning controlling run-off from a 25-year storm. |
| Use and Management of Containers | UAC R315-8-9 | Establishes standards for management of hazardous waste in containers. State analog to 40 CFR 264 Subpart I. | Not an ARAR. The use of containers is not contemplated for this removal action. |

**Action-Specific Applicable or Relevant and Appropriate Requirements**
**American Fork Canyon Site, Utah**

| | | | |
|---|---|---|---|
| Tanks | UAC R315-8-10 | Establishes standards for management of hazardous waste in tanks. State analog to 40 CFR 264 Subpart J. | Not an ARAR. The use of tanks is not contemplated for this removal action. |
| Waste Piles | UAC R315- 8-12 | Establishes standards for treatment and storage of hazardous waste in waste piles. State analog to 40 CFR 264 Subpart L. | Not an ARAR. Treating wastes in piles is not contemplated for this removal action. |
| Landfills | UAC R315- 8-14 | Establishes standards for landfill closure of hazardous waste. State analog to 40 CFR 264 Subpart N. | R315-8-14.5 provides general statements concerning landfill closure, e.g., maintain the integrity of the cover. These are relevant and appropriate. |
| Corrective Action Management Units (CAMUs) and Temporary Units | UAC R315- 8-21 | Establishes requirements for designation of a CAMU and defines management practices. State analog to 40 CFR Part 264 Subpart S. | Not an ARAR – not conducting a RCRA corrective action. |
| Emergency Controls | UAC R315-9 | Outlines requirements for emergency controls of hazardous waste spills. | Applicable in the event of a hazardous waste spill during the removal action. |
| Land Disposal Restrictions | UAC R315-13 | Outlines land disposal restrictions for hazardous waste. State analog to 40 CFR Part 268. | Not an ARAR. Removal action will not trigger land ban requirements. |
| Clean-up Action and Risk-Based Closure Standards | UAC R315-101 | Establishes risk-based closure standards for management of sites contaminated with hazardous waste or hazardous waste constituents. | Relevant and appropriate. Cleanup levels for this removal action have been determined based on a stream-lined risk assessment. |
| Corrective Action Cleanup Standards Policy – CERCLA and Underground Storage Tank sites | UAC R311-211 | Addresses cleanup requirements at CERCLA and UST sites. | Substantive portions may be relevant and appropriate. |
| **Utah Water Quality Act** | Title 19 UCA Chapter 5 | | |

**Action-Specific Applicable or Relevant and Appropriate Requirements**
**American Fork Canyon Site, Utah**

| | | | |
|---|---|---|---|
| Definitions and General Requirements | UAC R317-1 | Provides definitions and general requirements for water quality in the State. Provides a prohibition against discharging to waters of the state in violation of standards without a permit. | Point source discharges to state waters are not contemplated for this removal action. Substantive requirements for controlling storm-water are ARARs. |
| Ground Water Quality and Protection Rule | UAC R317-6 | Standards for protection of ground water. Establishes ground water classes (R317-6-3) and associated levels of protection (R317-6-4). Requires a permit for the direct or indirect discharge of pollutants into ground water. | Not an ARAR. Removal action is intended to eliminate potential direct or indirect discharges of pollutants to ground water. |
| Utah Pollutant Discharge Elimination System Requirements | UAC R317-8 | Establishes general requirements, definitions, and criteria/standards for technology-based treatment for point sources and provides pre-treatment requirements for storm-water runoff. | Substantive requirements for storm-water control during construction activities are ARARs. |

# APPENDIX D

## Technical Removal Action Alternatives Cost Estimates

Engineer's Preliminary Estimate
Alternative 1 – Institutional Controls to Limit Access

Engineer's Preliminary Estimate
Alternative 2 – On-Site Engineered Cell (Pacific Repository)

Engineer's Preliminary Estimate
Alternative3– Capping Contaminated Wastes In Place

Engineer's Preliminary Estimate
Alternative 4 – Control Runon and Runoff at Waste Deposits

Engineer's Preliminary Estimate
Alternative 5 – Proposed Combined Alternative

Payment Document – FS Contract #50-84N8-2-053
American Fork Mine Reclamation – October 31, 2003

Source:

Contracting Officer's Representative
Contract Administration File
Uinta National Forest
2003

**ENGINEER'S PRELIMINARY ESTIMATE** EE/CA - December 2004

**ALTERNATIVE 1 - INSTITUTIONAL CONTROLS TO LIMIT ACCESS**

| Item Number | Description | Site Identification | Units of Measurement | Method of Measurement | Quantity | Unit Price | Total Cost |
|---|---|---|---|---|---|---|---|
| 304(10) | Crushed Aggregate | Cap Road At Pacific Mine | Cubic Yards | Actual Quantity | 62 | $50.00 | $3,100 |
| 601(01) | Mobilization | All sites | Lump Sum | LS Quantity | 1 | $2,840.00 | $2,840 |
| 606(01)a | Guardrail Barrier (CorTen) | Pacific Mine | Feet | AQ | 300 | $18.00 | $5,400 |
| 606(01)b | Guardrail Barrier (CorTen) | Pacific Mill | Feet | AQ | 6 | $120.00 | $720 |
| 606(01)d | Guardrail Barrier (CorTen) | Scotchman | Feet | AQ | 50 | $18.00 | $900 |
| 607(03) | Gate, road closure, 15 feet | Blue Rock | Each | AQ | 2 | $750.00 | $1,500 |
| 606(02)a | Terminal Section | Pacific Mine | Each | AQ | 6 | $120.00 | $720 |
| 606(02)b | Terminal Section | Pacific Mill | Each | AQ | 4 | $120.00 | $480 |
| 606(02)d | Terminal Section | Scotchman | Each | AQ | 2 | $120.00 | $240 |
| 633(12) | Sign, closure | All Sites | Each | AQ | 6 | $350.00 | $2,100 |

| TOTAL COST | $18,000 |
|---|---|

| ENGINEER'S PRELIMINARY ESTIMATE<br>ALTERNATIVE 2 - ON-SITE ENGINEERED CELL (Pacific Repository) | | | | | | EE/CA - December 2004 | |
|---|---|---|---|---|---|---|---|
| Item Number | Description | Site Identification | Units of Measurement | Method of Measurement | Quantity | Unit Price | Total Cost |
| 201(03) | Clearing and Grubbing | Pacific Repository | Lump Sum | LS Quantity | 1 | $1,000.00 | $1,000 |
| 203(02)a | Excavation, Pacific Mine | Pacific Mine | Cubic Yards | Design Quantity | 3500 | $2.00 | $7,000 |
| 203(02)b | Excavation, Pacific Mill | Pacific Mill | Cubic Yards | DQ | 500 | $15.00 | $7,500 |
| 203(02)c | Excavation, Blue Rock | Blue Rock | Cubic Yards | DQ | 3000 | $5.40 | $16,200 |
| 203(02)d | Excavation, Scotchman | Scotchman | Cubic Yards | DQ | 1000 | $5.40 | $5,400 |
| 203(08) | Borrow Excavation | Borrow Area Repos. Cap | Cubic Yards | DQ | 3500 | $5.60 | $19,600 |
| 203(18) | Interceptor Ditch | Pacific Repository | Feet | Actual Quantity | 180 | $1.25 | $225 |
| 204(05) | Straw/hay bales | All Sites | Each | AQ | 20 | $30.00 | $600 |
| 204(07) | Silt Fence | All Sites | Feet | AQ | 700 | $2.00 | $1,400 |
| 210(03) | Road Obliteration | Blue Rock | Feet | AQ | 400 | $3.00 | $1,200 |
| 249(02) | Compositie Road Construction | Pacific Repository | Lump Sum | LSQ | 1 | $2,000.00 | $2,000 |
| 251(01) | Placed Riprap Interceptor Ditch | Pacific Repository | Cubic Yards | AQ | 45 | $25.00 | $1,125 |
| 306(01) | Reconditioning of Roadbed | Blue Rock | Feet | AQ | 400 | $1.50 | $600 |
| 601(01) | Mobilization | All sites | Lump Sum | LSQ | 1 | $3,930.00 | $3,930 |
| 603(01) | 18" HDPE Culvert | Pacific Repository | Feet | AQ | 22 | $25.00 | $550 |
| 603(2) | Special Pipe Connector | Pacific Mine Adit | Lump Sum | LSQ | 1 | $500.00 | $500 |
| 603B(03) | Adjust Ground Water Well | Pacific Repository | Lump Sum | LSQ | 1 | $500.00 | $500 |
| 624(02) | Strip, Stockpile, Replace Topsoil | Borrow Area | Lump Sum | LSQ | 1 | $700.00 | $700 |
| 625(02) | Seeding, Mulch, Fertilizer | All Sites | Acre | AQ | 2 | $3,200.00 | $6,400 |
| 625(07) | Erosion Control Blanket | Pacific Mill | Square Yard | AQ | 185 | $2.00 | $370 |
| 633(12)a | Sign, closure | All Sites | Each | AQ | 6 | $350.00 | $2,100 |
| 633(12)b | Sign, interpretive | Pacific Mine | Each | AQ | 1 | $2,000.00 | $2,000 |
| | | | | | SUBTOTAL COST | | $80,900 |
| IMPERVIOUS LINER UNDER SOIL CAP AT REPOSITORY<br>If required by Regulatory Agencies | | | | | | | |
| 221(02) | Composite Liner | Pacific Repository | Square Yard | AQ | 3900 | $14.00 | $54,600 |
| 601(01) | Additional Mobilization | Pacific Repository | Lump Sum | LSQ | 1 | $3,000.00 | $3,000 |
| | | | | | TOTAL COST | | $138,500 |

**ENGINEER'S PRELIMINARY ESTIMATE** EE/CA - December 2004

**ALTERNATIVE 3 - CAPPING CONTAMINATED WASTES IN PLACE**

| Item Number | Description | Site Identification | Units of Measurement | Method of Measurement | Quantity | Unit Price | Total Cost |
|---|---|---|---|---|---|---|---|
| 201(03) | Clearing and Grubbing | Pacific Mine and Mill | Lump Sum | LSQ | 1 | $1,000.00 | $1,000.00 |
| 203(01) | Reshape Waste Pile, Pacific Mine | Pacific Mine | Cubic Yards | Design Quantity | 3500 | $2.00 | $7,000.00 |
| 203(02) | Borrow Excavation | Borrow Area Pacific Cap | Cubic Yards | Design Quantity | 3000 | $5.60 | $16,800.00 |
| 203(18) | Interceptor Ditch | Pacific Mine | Feet | Actual Quantity | 160 | $1.25 | $200 |
| 204(05) | Straw/hay bales | All Sites | Each | AQ | 20 | $30.00 | $600 |
| 204(07) | Silt Fence | All Sites | Feet | AQ | 700 | $2.00 | $1,400 |
| 249(02) | Compositie Road Construction | Pacific Mine | Lump Sum | LSQ | 1 | $2,000.00 | $2,000 |
| 251(01) | Placed Riprap Interceptor Ditch | Pacific Mine | Cubic Yards | AQ | 40 | $25.00 | $1,000 |
| 306(01) | Reconditioning of Roadbed | Blue Rock | Feet | AQ | 400 | $1.50 | $600 |
| 601(01) | Mobilization | All sites | Lump Sum | LSQ | 1 | $3,900.00 | $3,900 |
| 602(01)b | Shot-Crete Cap Pacific Mill | Pacific Mill | Square Yard | Actual Quantity | 185 | $10.00 | $1,850.00 |
| 602(01)c | Shot-Crete Cap Blue Rock | Blue Rock | Square Yard | Actual Quantity | 1400 | $10.00 | $14,000.00 |
| 602(01)d | Shot-Crete Cap Scotchman | Scotchman | Square Yard | Actual Quantity | 200 | $10.00 | $2,000.00 |
| 603(01) | 18" HDPE Culvert | Pacific Mine | Feet | AQ | 22 | $25.00 | $550 |
| 603B(03) | Adjust Ground Water Well | Pacific Mine | Lump Sum | LSQ | 1 | $500.00 | $500 |
| 624(02) | Strip, Stockpile, Replace Topsoil | Borrow Area | Lump Sum | LSQ | 1 | $700.00 | $700 |
| 625(02) | Seeding, Mulch, Fertilizer | Pacific Mine Borrow Area | Acre | AQ | 1.5 | $3,200.00 | $4,800 |
| 633(12) | Sign, closure | All Sites | Each | AQ | 6 | $350.00 | $2,100.00 |

| TOTAL COST | $61,000.00 |
|---|---|

**IMPERVIOUS LINER UNDER SOIL CAP AT REPOSITORY**

If required by Regulatory Agencies

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 221(02) | Composite Liner | Pacific Repository | Square Yard | AQ | 3300 | $14.00 | $46,200 |
| 601(01) | Additional Mobilization | Pacific Repository | Lump Sum | LSQ | 1 | $3,000.00 | $3,000 |

| TOTAL COST | $110,200 |
|---|---|

**ENGINEER'S PRELIMINARY ESTIMATE** EE/CA - December 2004

**ALTERNATIVE 4 - CONTROL RUNON AND RUNOFF AT WASTE DEPOSITS**

| Item Number | Description | Site Identification | Units of Measurement | Method of Measurement | Quantity | Unit Price | Total Cost |
|---|---|---|---|---|---|---|---|
| 201(03) | Clearing and Grubbing | Pacific Mine Blue Rock | Lump Sum | LS Quantity | 1 | $1,500.00 | $1,500 |
| 203(18) | Interceptor Ditch | Pacific Repository | Feet | Actual Quantity | 200 | $5.50 | $1,100 |
| 204(05) | Straw/hay bales | All Sites | Each | AQ | 20 | $30.00 | $600 |
| 204(07) | Silt Fence | All Sites | Feet | AQ | 200 | $2.00 | $400 |
| 306(01) | Reconditioning of Roadbed | Blue Rock | Feet | AQ | 400 | $1.50 | $600 |
| 251(01)a | Placed Riprap Interceptor Ditch | Pacific Mine | Cubic Yards | AQ | 45 | $100.00 | $4,500 |
| 251(01)c | Placed Riprap Blue Rock Toe Along Channel | Blue Rock | Cubic Yards | AQ | 20 | $130.00 | $2,600 |
| 251(01)d | Placed Riprap Scotchman Toe Along River | Scotchman | Cubic Yards | AQ | 60 | $130.00 | $7,800 |
| 601(01) | Mobilization | All sites | Lump Sum | LS Quantity | 1 | $3,000.00 | $2,750 |
| 603(2) | Special Pipe Connector | Pacific Mine Adit | Lump Sum | LSQ | 1 | $750.00 | $750 |

| TOTAL COST | $19,000 |
|---|---|

**ENGINEER'S PRELIMINARY ESTIMATE** EE/CA - December 2004

**ALTERNATIVE 5 - PROPOSED COMBINED ALTERNATIVE**

| Item Number | Description | Site Identification | Units of Measurement | Method of Measurement | Quantity | Unit Price | Total Cost |
|---|---|---|---|---|---|---|---|
| 201(03) | Clearing and Grubbing | Pacific Repository | Lump Sum | LS Quantity | 1 | $1,000.00 | $1,000 |
| 203(02)a | Excavation, Pacific Mine | Pacific Mine | Cubic Yards | Design Quantity | 3500 | $2.00 | $7,000 |
| 203(02)b | Excavation, Pacific Mill | Pacific Mill | Cubic Yards | DQ | 500 | $15.00 | $7,500 |
| 203(02)c | Excavation, Blue Rock | Blue Rock | Cubic Yards | DQ | 3000 | $5.40 | $16,200 |
| 203(02)d | Excavation, Scotchman | Scotchman | Cubic Yards | DQ | 1000 | $5.40 | $5,400 |
| 203(08) | Borrow Excavation | Borrow Area Repos. Cap | Cubic Yards | DQ | 3500 | $5.60 | $19,600 |
| 203(18) | Interceptor Ditch | Pacific Repository | Feet | Actual Quantity | 180 | $1.25 | $225 |
| 204(05) | Straw/hay bales | All Sites | Each | AQ | 20 | $30.00 | $600 |
| 204(07) | Silt Fence | All Sites | Feet | AQ | 700 | $2.00 | $1,400 |
| 210(03) | Road Obliteration | Blue Rock | Feet | AQ | 400 | $3.00 | $1,200 |
| 249(02) | Compositie Road Construction | Pacific Repository | Lump Sum | LSQ | 1 | $2,000.00 | $2,000 |
| 251(01) | Placed Riprap Interceptor Ditch | Pacific Repository | Cubic Yards | AQ | 45 | $25.00 | $1,125 |
| 306(01) | Reconditioning of Roadbed | Blue Rock | Feet | AQ | 400 | $1.50 | $600 |
| 601(01) | Mobilization | All sites | Lump Sum | LSQ | 1 | $4,810.00 | $4,810 |
| 603(01) | 18" HDPE Culvert | Pacific Repository | Feet | AQ | 22 | $25.00 | $550 |
| 603(2) | Special Pipe Connector | Pacific Mine Adit | Lump Sum | LSQ | 1 | $500.00 | $500 |
| 603B(03) | Adjust Ground Water Well | Pacific Repository | Lump Sum | LSQ | 1 | $500.00 | $500 |
| 606(01)a | Guardrail Barrier (CorTen) | Pacific Mine | Feet | AQ | 600 | $18.00 | $10,800 |
| 606(01)b | Move Existing Guardrail | Pacific Mine | Feet | AQ | 300 | $9.00 | $2,700 |
| 606(02)a | Terminal Section | Pacific Mine | Each | AQ | 6 | $120.00 | $720 |
| 624(02) | Strip, Stockpile, Replace Topsoil | Borrow Area | Lump Sum | LSQ | 1 | $700.00 | $700 |
| 625(02) | Seeding, Mulch, Fertilizer | All Sites | Acre | AQ | 2 | $3,200.00 | $6,400 |
| 625(07) | Erosion Control Blanket | Pacific Mill | Square Yard | AQ | 185 | $2.00 | $370 |
| 633(12)a | Sign, closure | All Sites | Each | AQ | 6 | $350.00 | $2,100 |
| 633(12)b | Sign, interpretive | Pacific Mine | Each | AQ | 1 | $2,000.00 | $2,000 |
| | | | | | | SUBTOTAL COST | $96,000 |

**IMPERVIOUS LINER UNDER SOIL CAP AT REPOSITORY**

If required by Regulatory Agencies

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 221(02) | Composite Liner | Pacific Repository | Square Yard | AQ | 3900 | $14.00 | $54,600 |
| 601(01) | Additional Mobilization | Pacific Repository | Lump Sum | LSQ | 1 | $3,000.00 | $3,000 |
| | | | | | | TOTAL COST | $153,600 |

GRANITE CONSTRUCTION COMPANY SINCE 1922

SUMMIT/WASATCH COUNTY OPERATIONS
2 SOUTH MAIN, SUITE 2B
HEBER CITY, UT 84032
ATTN: ANDY DAHMEN

# INVOICE
# AMERICAN FORK MINE RECLAMATION
# CONTRACT # 50-84-N8-2-053

Customer:

USDA Forest Service
Attention: Ms. Jo Lippire
2222 West 2300 South
Salt Lake City, UT 84119

Invoice #: 007
Invoice Date: October 31, 2003
Job #: 232206

Remit To:

Granite Construction Company
Bank Of America
1850 Gateway Boulevard
Concord, CA 94520
VXP031250120

Tin # 940519552

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| | |
|---|---|
| Total Work Completed to Date: | $791,476.65 |
| Less, Amount Previously Billed: | $708,046.15 |
| **TOTAL THIS INVOICE:** | **$83,430.50** |

Approved For Payment
November 9, 2003
C.O.R.

**PAY ESTIMATE**
**AMERICAN FORK MINE RECLAMATION**
**CONTRACT #50-84N8-2-053**
**October, 31 2003**

| ITEM # | DESCRIPTION | UNITS | BID QUANTITY | BID UNIT PRICE | BID TOTAL | PREVIOUS QUANTITY | PREVIOUS TOTAL | MONTHLY QUANTITY | MONTHLY TOTAL | TOTAL QUANTITY | PERCENT COMPLETE | TOTAL TO DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Base Bid Package** | | | | | | | | | | | | |
| 201(03) | Clearing and Grubbing | LS | 1 | $20,000.00 | $20,000.00 | 1.00 | $20,000.00 | 0.00 | $0.00 | 1 | 100% | $20,000.00 |
| 202(05) | Remove Pole Fence | LS | 1 | $1,500.00 | $1,500.00 | 1.00 | $1,500.00 | 0.00 | $0.00 | 1 | 100% | $1,500.00 |
| 203(02)a | Ex. Keyway and Underdrain | CY | 1,400 | $5.20 | $7,280.00 | 1246.00 | $6,479.20 | 0.00 | $0.00 | 1,246 | 89% | $6,479.20 |
| 203(02)b | Ex. Evaporation Pond | CY | 500 | $6.20 | $3,100.00 | 500.00 | $3,100.00 | 0.00 | $0.00 | 500 | 100% | $3,100.00 |
| 203(02)c | Ex. Repository to Stockpile | CY | 20,470 | $3.95 | $80,856.50 | 20262.00 | $80,034.90 | 0.00 | $0.00 | 20,262 | 99% | $80,034.90 |
| 203(02)d | Ex. Dutchman Flat | CY | 6,200 | $1.95 | $12,090.00 | 6181.00 | $12,052.95 | -100.00 | -$195.00 | 6,081 | 98% | $11,857.95 |
| 203(02)e | Ex. Dutchman Mil | CY | 100 | $15.00 | $1,500.00 | 100.00 | $1,500.00 | 0.00 | $0.00 | 100.00 | 100% | $1,500.00 |
| 203(02)f | Ex. Pacific | CY | 25,400 | $4.95 | $125,730.00 | 17710.00 | $87,664.50 | 0.00 | $0.00 | 17710.00 | 70% | $87,664.50 |
| 203(11)a | Embank Keyway and Berm | CY | 1,040 | $3.00 | $3,120.00 | 1040.00 | $3,120.00 | 0.00 | $0.00 | 1040.00 | 100% | $3,120.00 |
| 203(19) | Strip Borrow Area | EA | 2 | $1,000.00 | $2,000.00 | 2.00 | $2,000.00 | 0.00 | $0.00 | 2.00 | 100% | $2,000.00 |
| 203(24) | Stream Crossing | LS | 1 | $1,802.00 | $1,802.00 | 1.00 | $1,802.00 | 0.00 | $0.00 | 1.00 | 100% | $1,802.00 |
| 203(25) | Temp Channel, Pacific Tailings | LF | 225 | $11.00 | $2,475.00 | 225.00 | $2,475.00 | 0.00 | $0.00 | 225.00 | 100% | $2,475.00 |
| 204(05) | Stray/Hay Bails | EA | 50 | $30.00 | $1,500.00 | 50.00 | $1,500.00 | 0.00 | $0.00 | 50.00 | 100% | $1,500.00 |
| 204(07) | Silt Fence | LF | 1,500 | $2.00 | $3,000.00 | 478.00 | $956.00 | 0.00 | $0.00 | 478.00 | 32% | $956.00 |
| 204(22) | Remove Water Evap. Pond | EA | 3 | $500.00 | $1,500.00 | 0.00 | $0.00 | 0.00 | $0.00 | 0.00 | 0% | $0.00 |
| 207(03) | Water | LS | 1 | $7,500.00 | $7,500.00 | 0.67 | $5,000.00 | 0.33 | $2,500.00 | 1.00 | 100% | $7,500.00 |
| 221(02)a | Composite Liner, Keyway | SY | 1,200 | $12.00 | $14,400.00 | 0.00 | $0.00 | 0.00 | $0.00 | 0.00 | 0% | $0.00 |
| 221(03) | Geomembrane Pond Liner | SY | 550 | $10.00 | $5,500.00 | 550.00 | $5,500.00 | 0.00 | $0.00 | 550.00 | 100% | $5,500.00 |
| 304(10) | Crushed Aggregate | CY | 440 | $45.00 | $19,800.00 | 473.00 | $21,285.00 | 0.00 | $0.00 | 473.00 | 108% | $21,285.00 |
| 308(05) | Recondition Roadbed | MILES | 0.25 | $22,000.00 | $5,500.00 | 0.25 | $5,500.00 | 0.00 | $0.00 | 0.25 | 100% | $5,500.00 |
| 310(01) | Mag Chloride | LS | 1 | $4,000.00 | $4,000.00 | 1.00 | $4,000.00 | 0.00 | $0.00 | 1.00 | 100% | $4,000.00 |
| 601(01) | Mobilization | LS | 1 | $15,000.00 | $15,000.00 | 1.00 | $15,000.00 | 0.00 | $0.00 | 1.00 | 100% | $15,000.00 |
| 6038(03)a | Adjust Monitoring Well | EA | 2 | $450.00 | $900.00 | 2.00 | $900.00 | 0.00 | $0.00 | 2.00 | 100% | $900.00 |
| 605(05) | 6" Collector Pipe | LF | 450 | $2.50 | $1,125.00 | 442.00 | $1,105.00 | 0.00 | $0.00 | 442.00 | 98% | $1,105.00 |
| 605(06) | 6" Outlet Pipe | LF | 50 | $4.00 | $200.00 | 50.00 | $200.00 | 0.00 | $0.00 | 50.00 | 100% | $200.00 |
| 605(07) | Course Granular Backfill | CY | 250 | $40.00 | $10,000.00 | 246.00 | $9,840.00 | 0.00 | $0.00 | 246.00 | 98% | $9,840.00 |
| **Subtotal Base Bid** | | | | | $351,378.50 | | $292,514.55 | | $2,305.00 | | | $294,819.55 |
| **Pacific Reclamation** | | | | | | | | | | | | |
| 203(11)b | Embank Pacific Tailings | CY | 9,400 | $4.70 | $44,180.00 | 8520.00 | $40,044.00 | 675.00 | $3,172.50 | 9195.00 | 98% | $43,216.50 |
| 203(16)b | Rock Lined Channel | LF | 320 | $13.00 | $4,160.00 | 177.00 | $2,301.00 | 0.00 | $0.00 | 177.00 | 55% | $2,301.00 |
| 203(16)c | Log Gradient Control Structure | EA | 4 | $150.00 | $600.00 | 4.00 | $600.00 | 0.00 | $0.00 | 4.00 | 100% | $600.00 |
| 6038(03)b | Adjust Monitoring Well | EA | 2 | $100.00 | $200.00 | 0.00 | $0.00 | 1.00 | $100.00 | 1.00 | 50% | $100.00 |
| 624(04)a | Placing Topsoil, Pacific | CY | 940 | $7.70 | $7,238.00 | 0.00 | $0.00 | 0.00 | $0.00 | 0.00 | 0% | $0.00 |
| 625(02)a | Seeding | ACRE | 2.53 | $3,200.00 | $8,096.00 | 0.00 | $0.00 | 2.53 | $8,096.00 | 2.53 | 100% | $8,096.00 |
| **Subtotal Pacific Reclamation** | | | | | $64,474.00 | | $42,945.00 | | $11,368.50 | | | $54,313.50 |

Approved For Payment
November 4, 2003
[illegible]
[illegible]

| ITEM # | DESCRIPTION | UNITS | BID QUANTITY | BID UNIT PRICE | BID TOTAL | PREVIOUS QUANTITY | PREVIOUS TOTAL | MONTHLY QUANTITY | MONTHLY TOTAL | TOTAL QUANTITY | PERCENT COMPLETE | TOTAL TO DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sultana Smelter** | | | | | | | | | | | | |
| 202(06) | Remove Rock Barrier | LS | 1 | $200.00 | $200.00 | 1.00 | $200.00 | 0.00 | $0.00 | 1.00 | 100% | $200.00 |
| 203(02)g | Ex. Sultana Smelter | CY | 800 | $5.20 | $4,160.00 | 800.00 | $4,160.00 | 0.00 | $0.00 | 800.00 | 100% | $4,160.00 |
| 203(11)c | Embank Sultana Smelter | CY | 1,370 | $4.70 | $6,439.00 | 1370.00 | $6,439.00 | 0.00 | $0.00 | 1370.00 | 100% | $6,439.00 |
| 203(22) | Rock Barrier Installed | LF | 80 | $3.00 | $240.00 | 378.00 | $1,134.00 | 0.00 | $0.00 | 378.00 | 473% | $1,134.00 |
| 624(04)b | Place Topsoil Sultana Smelter | CY | 205 | $6.50 | $1,332.50 | 205.00 | $1,332.50 | 0.00 | $0.00 | 205.00 | 100% | $1,332.50 |
| 625(02)b | Seeding | ACRE | 0.32 | $3,200.00 | $1,024.00 | 0.00 | $0.00 | 0.32 | $1,024.00 | 0.32 | 100% | $1,024.00 |
| **Subtotal Sultana Smelter** | | | | | **$13,395.50** | | **$13,265.50** | | **$1,024.00** | | | **$14,289.50** |
| **Wild Dutchman** | | | | | | | | | | | | |
| 230(02)h | Ex. Wild Dutchman | CY | 8,350 | $4.70 | $39,245.00 | 19363.00 | $91,006.10 | 0.00 | $0.00 | 19363.00 | 232% | $91,006.10 |
| 210(05)a | Obliterate Haul Roads | LF | 900 | $3.00 | $2,700.00 | 0.00 | $0.00 | 1,000.00 | $3,000.00 | 1000.00 | 111% | $3,000.00 |
| 306(09) | Recondition Haul Roads | MILE | 0.25 | $7,500.00 | $1,875.00 | 0.25 | $1,875.00 | 0.00 | $0.00 | 0.25 | 100% | $1,875.00 |
| 625(02)c | Seeding | ACRE | 1.25 | $3,200.00 | $4,000.00 | 0.00 | $0.00 | 1.25 | $4,000.00 | 1.25 | 100% | $4,000.00 |
| **Subtotal Wild Dutchman** | | | | | **$47,820.00** | | **$92,881.10** | | **$7,000.00** | | | **$99,881.10** |
| **Bay State** | | | | | | | | | | | | |
| 203(02)i | Ex. Bay State | CY | 1,350 | $4.70 | $6,345.00 | 2324.00 | $10,922.80 | 0.00 | $0.00 | 2324.00 | 172% | $10,922.80 |
| 210(05)b | Obliterate Haul Roads | LF | 950 | $1.30 | $1,235.00 | 0.00 | $0.00 | 1,150.00 | $1,495.00 | 1150.00 | 121% | $1,495.00 |
| 249 (03) | Temporary Haul Road | LF | 950 | $2.00 | $1,900.00 | 950.00 | $1,900.00 | 0.00 | $0.00 | 950.00 | 100% | $1,900.00 |
| 625(02)d | Seeding | ACRE | 0.36 | $3,200.00 | $1,152.00 | 0.00 | $0.00 | 0.36 | $1,152.00 | 0.36 | 100% | $1,152.00 |
| **Subtotal Bay State** | | | | | **$10,632.00** | | **$12,822.80** | | **$2,647.00** | | | **$15,469.80** |
| **Repository Cover** | | | | | | | | | | | | |
| 203(11)d | Embank Repository Cover | CY | 9,700 | $5.20 | $50,440.00 | 9700.00 | $50,440.00 | -943.00 | -$4,903.60 | 8757.00 | 90% | $45,536.40 |
| 203(18)a | Interceptor Ditch | LF | 655 | $1.20 | $786.00 | 620.00 | $744.00 | 35.00 | $42.00 | 655.00 | 100% | $786.00 |
| 203(23) | Reshape Topsoil Borrow Area | LS | 1 | $1,000.00 | $1,000.00 | 0.00 | $0.00 | 1.00 | $1,000.00 | 1.00 | 100% | $1,000.00 |
| 221(02)b | Composite Liner Repository | SY | 13,700 | $13.00 | $178,100.00 | 0.00 | $0.00 | 0.00 | $0.00 | 0.00 | 0% | $0.00 |
| 251(01) | RipRap CL 7 Interceptor Ditch | CY | 470 | $22.50 | $10,575.00 | 0.00 | $0.00 | 480.00 | $10,800.00 | 480.00 | 102% | $10,800.00 |
| 606(01) | Guardrail System CRT Type IV | LF | 750 | $17.00 | $12,750.00 | 0.00 | $0.00 | 750.00 | $12,750.00 | 750.00 | 100% | $12,750.00 |
| 606(02) | Terminal End Section | EA | 10 | $115.00 | $1,150.00 | 0.00 | $0.00 | 8.00 | $920.00 | 8.00 | 80% | $920.00 |
| 624(04)c | Placing Topsoil, Repository | CY | 2,200 | $5.20 | $11,440.00 | 0.00 | $0.00 | 1,143.00 | $5,943.60 | 1143.00 | 52% | $5,943.60 |
| 625(02)e | Seeding | ACRE | 6.26 | $3,200.00 | $20,032.00 | 0.00 | $0.00 | 6.26 | $20,032.00 | 6.26 | 100% | $20,032.00 |
| 633(12) | Sign Closure | EA | 4 | $350.00 | $1,400.00 | 0.00 | $0.00 | 4.00 | $1,400.00 | 4.00 | 100% | $1,400.00 |
| **Subtotal Repository Cover** | | | | | **$287,673.00** | | **$51,184.00** | | **$47,984.00** | | | **$99,168.00** |
| **TOTALS THIS PERIOD** | | | | | **$775,373.00** | | **$505,612.95** | | **$72,328.50** | | **75%** | **$577,941.45** |
| **Modifications to contract** | | | | | | | | | | | | |
| MOD 2 | HDPE Liner materials | SF | 0 | $0.28 | $0.00 | 0.00 | $0.00 | 0.00 | $0.00 | 0.00 | | $0.00 |
| MOD 2 | TENAX TD9 Geonet | SF | 0 | $0.46 | $0.00 | 0.00 | $0.00 | 0.00 | $0.00 | 0.00 | | $0.00 |
| MOD 2 | X300 GEPTX | SY | 0 | $0.09 | $0.00 | 0.00 | $0.00 | 0.00 | $0.00 | 0.00 | | $0.00 |
| MOD 3 | 221 (02)a Composite Liner Key | SY | 1200 | $13.95 | $16,740.00 | 1200.00 | $16,740.00 | 0.00 | $0.00 | 1200.00 | 100% | $16,740.00 |
| MOD 3 | 221 (02)b Composite Liner Rep | SY | 13700 | $15.20 | $208,240.00 | 12026.00 | $182,795.20 | 0.00 | $0.00 | 12026.00 | 88% | $182,795.20 |
| MOD 4 | Temporay Fence | LS | 1 | $2,898.00 | $2,898.00 | 1.00 | $2,898.00 | 0.00 | $0.00 | 1.00 | 100% | $2,898.00 |
| MOD 5 | Remove Pond/Fence | LS | 1 | $4,760.00 | $4,760.00 | 0.00 | $0.00 | 1.00 | $4,760.00 | 1.00 | 100% | $4,760.00 |
| MOD 6 | Added Repository Embankment | CY | 1500 | $1.00 | $1,500.00 | 0.00 | $0.00 | 1,342.00 | $1,342.00 | 1342.00 | 89% | $1,342.00 |
| MOD 7 | Log Barriers | LS | 1 | $5,000.00 | $5,000.00 | 0.00 | $0.00 | 1.00 | $5,000.00 | 1.00 | 100% | $5,000.00 |
| **Subtotal Modifications** | | | | | **$239,138.00** | | **$202,433.20** | | **$11,102.00** | | | **$213,535.20** |
| **TOTAL WITH MODIFICATIONS** | | | | | **$1,014,511** | | **$708,046.15** | | **$83,430.50** | | | **$791,476.65** |

Approved For Payment
November 9,

# APPENDIX E

**Correspondence Applicable to Proposed Removal Action**

Letter with Comments on FS' EE/CA from Utah Environmental Congress
Forest Service Response to Comments from Utah Environmental Congress
Dialogue Between TU and UDEQ Concerning ARAR's for Pacific Mine

Sources:

Administrative Record for AFC Removal Action
TU Project Manager's E-mail File


May 9, 2002

Uinta National Forest
Attn: Ted Fitzgerald
88 West 100 North
PO Box 1428
Provo, UT 84603-1428

Dear Ted,

The UEC appreciates the opportunity to comment on the Engineering Evaluation and Cost Analysis (EE/CA) for removal of the mine, mill, and smelter wastes in the North Fork of American Fork Canyon.

The UEC supports the clean-up and rehabilitation of areas that have been heavily impacted by past mining activity. The UEC will focus its comments on the wildlife species, water, and vegetation that will be impacted in the process of mine cleanup and "capping" or storage. This includes the additional impacts that may occur due to removal activities including road construction, expanded ATV use, and additional damage to wetland areas.

The EE/CA provided good information in the risk assessment regarding contamination levels. The possible extent of impact to wildlife and plant species at the waste sites is alarming, especially given the persistence of heavy metal contamination in plant and animal tissues. The relocation and capping of this material should be completed to the extent that wildlife will not be further contaminated.

The UEC has the following comments regarding possible impacts to wildlife, water, and vegetation:

American Fork River, Wetlands, and wet areas-According to the EE/CA, the Pacific tailings deposit impinges on the North Fork of American Fork River, in places forming the banks of the stream. This tailings deposit is the focus of much of the work that will take place on the project. Alteration of the tailings pile will include alteration of stream beds and banks requiring 404 permit consultation with the Army Corps of Engineers. The Uinta NF should consult with state and federal agencies regarding degradation permits (NPDES and UPDES) to determine how they will apply to this project. The Uinta NF should determine the extent that adjacent wetlands and wet areas will be altered during the removal process. The resulting impacts to the wet areas should be mitigated and restored to as natural a condition that is possible. The Uinta NF should consult with the Army Corps of Engineers as part of the planning process. Additional impacts to wildlife, water, and vegetation that may result from removal in wet areas should be determined and mitigated to the extent possible.
Wildlife-The EE/CA states that TES species will not be jeopardized by the removal action. What surveys has the Uinta NF performed to determine the status and trend of wildlife species in the project area? What species exist in or use the project area? The UEC requests that the Uinta NF perform surveys for any TES plants and animals that may exist in the project area.

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www.uec-utah.org

-The Bonneville Cutthroat Trout (BCT) is a Region 4 sensitive species that is impacted by metals contamination from the tailings piles. The proposed action of tailings removal will likely make impacts more severe before the project is completed (which is intended to reduce current impacts). Impacts from removal may include increased sediment to stream channels and introduction of contaminants from heavy equipment (diesel, hydraulic fluid, additional sediment), especially due to impacts from construction of the proposed stream crossing. The UEC requests that the Uinta monitor and gather hard data to determine the status and trend of the BCT populations in American Fork River. Hard data can then be used to determine how the proposed action will impact the BCT populations. Regarding fishing in the watershed; the UEC suggests that the entire American Fork watershed be closed to fishing to protect public health.

Alteration of wetland habitat during the removal process may be detrimental to wildlife species. What species (birds, mollusks, plants, mammals) exist in these wetlands? The Uinta should perform surveys for these species and mitigate any possible negative impacts.

Roads-The removal project will involve the use of heavy equipment, including hauling trucks. Road construction and improvement should be kept to a minimum to facilitate cap and removal actions. The UEC requests that the Uinta include a strict road closure action with reclamation activities that will rip and reseed routes that are not included in the travel plan. No net gain in road densities or improvements should result from removal and reclamation actions. The UEC requests that the Uinta develop a complete travel plan for the project detailing the roads that will be used for the removal action. The travel plan should include the level of road improvement for planned routes, any new routes, and the plans to reclaim these routes when removal is complete.

Illegal ATV use is pervasive in Mineral Basin and the surrounding areas. The UEC is concerned with the extent of road building and reconstruction and its relationship to ATV use. The lack of maps or a specific section in the EE/CA describing travel management for the project is disconcerting. Given the past problems with illegal ATV use, the Uinta NF must be mindful and very specific regarding road and route planning for the removal action. The UEC has the following comments and questions:

-The main road into Mineral Basin should be closed (administrative closure) during the removal process to reduce the level of traffic and ensure public safety.

-Major road improvements must be kept to a minimum for the removal action.

-The Uinta NF should create a plan to close routes after the project is complete. Any improvement in roads will facilitate ATV access after the removal is complete.

-Any road constructed to access tailings (i.e., Bay State) must be ripped, recontoured, and reseeded to prevent further use.

-Disclose any impacts to water, wildlife, plants, or vegetation that may result from the use of magnesium chloride on roads.

Recreation Use-The EE/CA comments several times on the constant problem with ATV use at, in, and on mine sites proposed for cleanup. This demonstrates a need for a strict road closure policy as part of reclamation planning. The Uinta NF must take measures to protect the intact resources that exist in American Fork Canyon. It is unfortunate that pervasive illegal ATV use necessitates the use of "guardrail" barriers to deter trespass; these barriers and signage should be used to educate and enforce illegal ATV use.

***Compliance with Environmental Law-***

The EE/CA attempts to provide assurance for protection of wildlife in Appendix C. This section identifies the resources on the forest that qualify under "Applicable or Relevant and Appropriate Requirements" (ARARs). The Uinta NF identified the resources and laws that apply to the removal action, these include: TES wildlife species (ESA), Protection of Wetlands, Clean Air Act and Clean Water Act regulations, Ground Water Protection, Floodplain management, Eagle Protection Act, Migratory Bird Treaty Act. The UEC requests that the Uinta NF

develop plans and display compliance with these laws in the EE/CA. This especially includes consultation with the proper agencies to ensure the complicity by the Uinta with the Appropriate and Relevant laws.

***Comments on Alternatives***- Development of each alternative is quite brief. The alternatives describe the general approach of the various possibilities for cleaning up, removing, or containing of the tailings, crushed rock, and slag materials that are found on the mine and other waste sites. The UEC's general comment regarding these proposals is as follows:

Alternative 1-The focus of this alternative is on controls to limit access to the tailings sites. Controls include plans for extensive and expensive barriers to prevent access to mine sites by mostly ATVs. Given the cost incurred by barriers and enforcement of the travel plan, the Uinta NF should consider one more alternative, a complete ban on ATV use in Mineral Basin.

Alternative 2-This alternative proposes to place the tailings pile at Dutchman Flat where the tailings will be piled, compacted and capped with a synthetic, low permeability cap. The capped tailings would then be covered with soil removed originally from the site and planted. According to the EE/CA, barricading and signing would be used "to discourage use of ATV's in this area". The UEC suggests that the Uinta NF ban all ATV use in Mineral Basin. The Uinta NF cannot afford to continue corralling illegal users at the cost of the taxpayer; this includes the extensive ecological and resource costs incurred by ATV use as well as the financial resources of the taxpayer. ATV's also create potential impacts to public health associated with ATV caused tailings exposure.

Alternative 3-This alternative appears to be a "quick fix" that will likely lead to more contamination problems in the future. Capping tailings in place does not resolve the issues of contact with ground and surface water, especially in spring run-off or other flood conditions.

Alternative 4-This alternative proposes construction of a reducing wetland to "clean" water before it is discharged into the American Fork River. The UEC suggests that this alternative would require significantly more development and analysis prior to its implementation. The likelihood for failure of this alternative appears to be high, as flood cycles and resource damage is quite likely to occur in the future. It appears that a reducing wetland would also continue to impact several species of wildlife as contaminants would be concentrated in desirable areas for wildlife.

Alternative 5-Simplified, this alternative provides for the diversion of water away from the tailings piles to prevent runon and runoff of surface water, which results in contamination. Given the high level of contamination in American Fork River and watershed, it appears as though diversion should have taken place many years ago. Srill, this alternative does not remove the tailings piles, which would remain in the floodplain and may continue to degrade the environment including contamination of wildlife. This alternative temporarily solve a part of the problem.

Per the conversation with Ted Fitzgerald on May 1, 2002, the Uinta NF preferred alternative includes Alternative 2 and parts of the other alternatives that will serve to make alternative 2 more protective. Given the preference to store the tailings at Dutchman Flat, the Uinta NF should analyze the long-term impacts of a storage facility at this site. This should include a 100-year floodplain analysis. It should also include analysis of impacts to wildlife and other forest resources that will be specific to the containment site.

***Specific Comments***-With regard to wildlife; we know no tissue samples of deer, elk, raptors, etc. have been taken to determine the level of contamination. EE/CA page 43 states that "wildlife surveys have not been conducted on any species to determine the numbers present at the Site". Numerous species use the area in breeding season and possibly for metallic salts. The UEC requests that surveys be completed through hunters and the DWR or some other method to determine whether hunting should be discontinued in the area. Until tissue

samples are completed, hunters should at least be warned that there is a possibility of health risks associated with eating deer/elk taken from the area. These health risks may be magnified in children.
-The UEC requests that the Uinta NF evaluate arsenic levels in water to determine if they comply with new arsenic standards for drinking water.
-Water sampling results from downstream sites should be displayed in the EE/CA. These results should be compared to state water quality standards as determined by the Utah Safe Drinking Water Act. This should be part of the formal document.
-The UEC requests that the Uinta NF create and include a project level travel plan in the final document that details the routes planned for use in the removal action. As stated above, the Uinta NF should survey and monitor for wildlife and plant species, especially MIS and TES that may be negatively affected by removal actions. Please keep us on the mailing list.

Sincerely,

Dave Bell, Resource Specialist

United States Department of Agriculture | Forest Service | Uinta National Forest | 88 West 100 North, P.O. Box 1428, Provo, UT 84603-1428

**File Code:** 2160
**Date:** May 20, 2002

Dave Bell
Resource Specialist
Utah Environmental Congress
1817 South Main Street #10
Salt Lake City, UT 84115

Dear Mr. Bell:

We have received your comments concerning the Engineering Evaluation and Cost Analysis (EE/CA) which addresses the proposed removal of contaminated mining wastes at five sites in American Fork Canyon. Your comments reflect the thorough review of the document that you and your colleagues invested in this project. Thank you for your interest in the management of the Uinta National Forest and your support of this project. To date we have received no other comments from other individuals, organizations, or local, State, or Federal agencies. This letter will address your comments, and with your letter, will be included in the project file and attached to the EE/CA as public comment.

The following responses are offered with reference to the headings in your comment letter. Let me clarify at the outset that the nature of this project (hazardous waste removal) exempts it from NEPA documentation. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) established the authorities and procedures followed for projects of this type. The EE/CA format does not include the environmental references you are accustomed to for typical Forest Service proposals, presumably because the environmental hazards associated with the contaminated mining wastes present a far greater risk to environmental health than the short-term impacts of the removal action. Similarly, the environmental inventories, analysis, consultations, concurrences and approvals are not required for CERCLA actions. Still we recognize the importance and value of these considerations and have incorporated them into our project planning. The EE/CA however is silent in this regard per standards established by the various Federal agencies involved in this work nationwide.

American Fork River, Wetlands, and wet areas

The proposed removal actions will not involve any earthmoving activities, vegetation disturbance, or dewatering in wetlands. The reclamation of the Pacific tailings, after removal of more than 20,000 cubic yards of heavy metal bearing tailings, will be done to create additional wetlands. It will be some time before the soils in the reclaimed area will support wetland vegetation types but this will occur as the oxidation ponds wet the soils and willow cuttings and wetland vegetation plugs are introduced to the area. This activity will be part of the effort following the removal action during monitoring and maintenance of the project by the Forest Service over the next several years. An operations, monitoring and maintenance plan will be developed as the removal actions are nearing completion which is the normal process for a project conducted under CERCLA. Since there is no disturbance to wetlands, and stream alteration responsibilities have been relegated to the State of Utah, the Army Corps of Engineers is not one of the agencies involved in this project.

The removal action at the Pacific tailings will involve the construction of a temporary crossing involving the installation of two culverts, side by side, in the North Fork of American Fork River to allow access to the work site and to eliminate the need for over 4000 truck entries into the river. Best management practices will be employed to keep sediment introduction to the river at a minimum. Silt fences and straw bales will be used to prevent soil introduction into the river. Contaminated water will not be discharged directly into the river though it is recognized that there will be some increased metal loadings in the river during removal activities.

The discussions and consultations you suggest with other agencies have already occurred and no permits or authorizations are required for these removal actions. Utah Department of Environmental Quality (UDEQ) is our primary State contact and they are fully informed about the project. The mitigation efforts to reduce impacts you suggest have been incorporated into the design of the project. The contractor that is selected to do this project is

required to prepare an erosion control plan, subject to Forest Service approval, to further emphasize the requirement to minimize disturbance to the environment.

Wildlife

The surveys of TES plants and animals you request be done in and around this project have been completed. In 2000 and 2001 we had biologists inventory the plant species found near the proposed work sites. After several weeks of inspection the only plants of concern located in the canyon are species that inhabit rocky slopes or cliff areas. The project will not impact any of these plants. A report was generated to summarize this effort and is available for review at this office.

Consultation with the U.S. Fish and Wildlife Service concerning potential impacts to threatened and endangered species in the project area has occurred. It was determined by our wildlife biologists that a project of this nature would have "No Effect" on any threatened or endangered species or their habitat. USF&WS concurred with that finding. A BE/BA is on file addressing these issues and is available for review at this office.

Impacts to the Bonneville Cutthroat Trout may increase as certain work activities occur. Installation of the temporary stream crossing will release some sediment in the stream channel, probably for a period of one day during installation and a couple of days when it is removed. There will be higher levels of heavy metals in the stream while Pacific tailings is being excavated. These occurrences are unavoidable but will be kept to a minimal impact through utilization of best management practices and use of sediment reduction techniques and filter materials. The impacts associated with these activities will not produce environmental conditions as severe as are presently occurring during spring runoff or by heavy precipitation events on a regular basis. These one-time, short-term impacts will occur during operations that will enhance the stream environment for all aquatic life from now on.

Roads

The concerns you address pertaining to road improvements and road densities have been considered in the design and implementation of the proposed project. The only road improvements that will be made are those necessary to accommodate the construction activities and stabilize the haul road, thus reducing impacts to the adjacent environment. Those improvements involve improving the road surface for 0.25 miles to remove large rock from the surface in the switchbacks and applying a dust palliative on 1.5 miles of road that will be used for hauling of materials to and from the repository.

A road will be constructed to access the Bay State site, about 900 feet in length. After the work at that site is completed the road will be obliterated and removed from service. There are two roads that access the Wild Dutchman site. Minor improvements will be made to those roads to accommodate the haul trucks but when the work is complete the roads will also be obliterated. The area will be monitored to ensure the obliterated roads are not used by recreational vehicles. The obliterated roads will be reseeded and the vegetation monitored and supplemented as necessary to reestablish native plant species on these areas.

-The road closure into Mineral Basin during hauling operations that you requested is included in the project plans.

-There will not be any major road improvements resulting from this project.

-The minor road improvements that will occur will have no affect on the level of ATV use occurring in the area.

-The road to be constructed to Bay State will be obliterated (ripped and recontoured) and revegetated.

-Research has been done by the industry, and others, to determine the potential detrimental effects associated with use of magnesium chloride (MgCl) as a dust palliative. This research was thoroughly studied by the Forest Service in years past before the use of MgCl on Forest roads was allowed. This application has become widespread during the last two decades and is a standard for use on numerous Forests and Forest roads. Detrimental environmental affects associated with MgCl are tied to accidents and mishaps where spills directly into streams or vegetated areas occur. The concentrations developed on treated road surfaces do not present environmental problems.

Recreational Use

The use of ATV's and other recreational vehicles are authorized for use on designated roads and trails in the North Fork of American Fork Canyon. The Pleasant Grove District has produced a brochure addressing proper ATV use and distributes it at the entrance station to the canyon. They have nine people patrolling the District this year to curtail unauthorized use of National Forest System lands, primarily by recreationists. That effort is financed through a combination of a Grant from the Utah State Parks and Recreation (with monies obtained from ATV and recreation vehicle registrations), the Fee Demo monies collected at the entrance station, and allocations for recreation to the Forest. These educational efforts and enforcement of travel regulations has reduced the amount of unauthorized use in restricted areas occurring in the canyon. But as is the case with most every activity, there are still individuals that violate the rules. The proposed repository will be a permanent facility to contain the potential hazardous wastes deposited there. The guardrail barrier is a precautionary measure to protect the site from activities potentially damaging to the cover, including but not limited to ATV use.

Compliance with Environmental Law

The concerns and requests you list in this section have been addressed above in this response.

Comments on Alternatives

Alternative 1-The use of ATV's on various sections of the Forest is addressed in the Forest's Travel Management Plan. A separate effort to eliminate this use in the North Fork of American Fork Canyon is not appropriate at the project level and is beyond the scope and authority under which this project is proposed.

Alternative 2-Your comments are tied to ATV use at the repository site and the canyon in general. Those comments are addressed previously in this response.

Alternative 3-Capping of the contaminated materials in place does not adequately address the concerns with all of the sites involved in the proposed project. This technique could be used effectively at Bay State and possibly at Wild Dutchman, and is being used by constructing the repository at Dutchman Flat and covering the wastes presently on that site. The long-term effectiveness of this approach at Pacific mine and Sultana Smelter would be dependent on storm and flood events as you note. For that reason we propose the construction of the repository. Because of the advantages of consolidating the wastes in one repository, moving the wastes from the other sites into the repository have become part of this proposed action rather than capping some sites in place.

Alternative 4-The reducing wetlands, though not a perfect solution, is a passive approach to reduce the heavy metal concentrations in the water being discharged from the plugged Pacific adit. This approach has been used in many locations throughout the western states and has shown a measure of effectiveness. We are proposing implementation of this technique at Pacific mine because there are no known economically acceptable alternatives. The only other option is to allow the water to enter the river without any effort to reduce the metal concentrations. It is considered prudent to develop the reducing wetlands and oxidation ponds during reclamation of the Pacific tailings area rather than make no effort to clean up the water.

Alternative 5-Your assessment of this alternative points out the reasons this approach is being considered in combination with other applications. It addresses one part of the complex problems associated with the mine wastes.

We have considered the long-term impacts associated with developing a repository at Dutchman Flat. It is because of ground water concerns that the repository site was moved to Dutchman Flat. Concerns about potential flooding also directed us to locate the repository at this site because it is well removed and elevated some 50 feet above the river, far above a 100-year flood event. Isolating the wastes in a capped repository will minimize the impacts to wildlife and other resources. Through proper maintenance of the repository (a commitment being made by the Forest Service through creation of the repository) the potential hazards associated with these particular wastes will be removed from the environment.

Specific Comments

Discussions centering on impacts to fish and wildlife, and the resulting impacts to humans from consumption of those animals, have been conducted with the Utah Division of Wildlife Resources, the Office of Epidemiology, Utah Division of Water Quality, UDEQ, and the Utah County Environmental Health Department. The health advisory related to consumption of native fish taken from American Fork River will be forthcoming in the spring of 2002. The authority and responsibility to conduct investigations concerning potential risks to human health associated with consumption of big game taken from this canyon rests with those agencies. The effort and expense required to determine potential impacts to big game species, passed on to humans, is not considered warranted without evidence supporting this concern. The risk assessment in the EE/CA does not provide that level of evidence.

The arsenic levels, or other heavy metal concentrations, in American Fork River were not compared to standards for drinking water because none of the water produced by this stream is utilized for culinary water supplies. The beneficial use of the water rights for American Fork River is for agriculture. A change of beneficial use to culinary water supply would initiate water quality determinations by the regulatory State agencies.

Development of a project level travel plan designating the roads to be used during the removal action basically exists in the plans being developed for the project. The only roads that will be used by the contractor in this effort are those addressed previously in this response. The project manager for the Forest Service (called a Contracting Officer's Representative) will be responsible for seeing that the Contractor uses only the approved roads and staging areas necessary for completion of the work.

Summary of Response

The EE/CA adequately addresses the requirements for this project. We have considered the concerns you expressed in your comments where applicable to the Forest Service's proposed removal actions. Some of your comments are beyond the authority of the Forest Service, or the scope of this proposed project as noted. We anticipate no changes to the EE/CA pending further comments specific to the CERCLA requirements. A decision document in the form of a Removal Action Memorandum issued by the Regional Forester should be forthcoming shortly. A copy of that document will be provided to you.

Sincerely,

Peter W. Karp

PETER W KARP
Forest Supervisor

**Ted Fitzgerald**

**From:** Ted Fitzgerald **Sent:** Wed 12/29/2004 1:30 AM
**To:** Ted Fitzgerald
**Cc:**
**Subject:** DIALOGUE BETWEEN TU AND UDEQ CONERNING ARAR'S FOR PACIFIC MINE
**Attachments:**

-----Original Message-----
**From:** Steve Thiriot [mailto:sthiriot@utah.gov]
**Sent:** Tue 11/9/2004 10:01 AM
**To:** Ted Fitzgerald
**Cc:**
**Subject:** Re: Pacific Mine Reclamation Project

I received your e-mail on the ARAR's for the above project. I have forwarded your e-mail to Mo Slam (801/536-4178) of DERR. He will likely have another person in our office (Duane Mortensen) review your ARAR info.

jst

>>> "Ted Fitzgerald" <TFitzgerald@tu.org> 11/08/04 01:38PM >>>
Hello Steve,
Last week I met with Pete Stevenson and Andy Lensink at EPA to discuss Trout Unlimited's (TU) proposed reclamation project of Pacific Mine in American Fork Canyon (AFC). Mr. Lensink is putting the final revisions on a draft Administrative Order on Consent (AOC) which when signed by EPA and TU will be the authorizing instrument to allow TU to conduct the proposed removal action. Before the AOC can be signed, an Engineering Evaluation and Cost Analysis (EE/CA) must be completed by TU and accepted by EPA. I am in the process of preparing the EE/CA by modifying the EE/CA that I used for the Forest Service's removal action of 2002-2003 in AFC.
A key consideration in the evaluation addresses the Applicable or Relevant and Appropriate Requirements (ARARs). Attached to this message is a copy of the ARAR section of the FS'S EE/CA consisting of a 2 page narrative talking to ARARs and a 12 page matrix which lists each of the requirements suggested by UDEQ when the FS's EE/CA was prepared.
It is my intent to use this same list and discussion of ARAR's for the Pacific Mine Removal Action EE/CA. Mr. Stevenson advised me that you are the contact at UDEQ to have this list varified as inclusive of the requirements considered potentially applicable to our proposed action at Pacific Mine.
This message is a request that you review the attached information and determine if it sufficiently addresses the ARAR considerations for our project. A response to this message reflecting your determination is solicited so I can proceed with the Pacific EE/CA. We are hopeful of having the EE/CA completed by early December for attachment to the AOC for EPA's internal review and concurrence with signature of the AOC to occur in January 2005. Your attention and assistance in this matter is necessary for us to meet these timeframes.
To further assist you in this review I am also attaching an outline of the individual work items that will occur during the removal action. As you can see it includes reshaping the waste rock pile at Pacific Mine, removing the contaminated soil from the hillside where the Pacific Mill was located, adding the Scotchman Mine waste rock pile, and the Blue Rock Mine waste rock pile to the Pacific wastes. All this material will be contained in a permanent repository at the current location of the Pacific Mine waste rock pile on lands owned by Mr. Dick Bass.
Thank you for your attention to this request.
Ted